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DETERMINATION OF THE PISCINE INTERMEDIATE HOSTS OF PHILIPPINE HETEROPHYID TREMATODES BY FEEDING EXPERIMENTS.[1]

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The recent works of Africa et al., associating the eggs of various species of heterophyid trematodes with fatal heart lesions in man(3, 4, 6, 8) as well as definite lesions in the cerebro-spinal system(5, 7) of the same host, have attracted considerable interest to this group of worms. As part of a general program to obtain information that may be of value in the prophylactic control of these trematodes in the future, the Department of parasitology, School of Hygiene and Public Health, University of the Philippines, has undertaken a series of feeding experiments to determine the piscine hosts of Philippine heterophyids. The present paper has been prepared in partial fulfillment of this project.

MATERIALS AND METHODS

In order to determine beforehand the species of fish that would be most likely to infect experimental animals to which they are fed with heterophyids, a systematic search for metacercariæ was made in fishes that to our knowledge are eaten raw or semiraw by a large number of Filipinos. To our surprise, most if not all of the species of fish we have so far found in-

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fested with metacercariæ which upon feeding to experimental animals yielded adult heterophyid flukes turned out to be marine forms; yet it seems to be the general impression that heterophyids infesting man usually utilize fresh-water fishes as second intermediate hosts. However, Ciurea(10) has found in the parasitic fauna of Roumania seven species of heterophyids derived from marine fishes.

The species of fish we have used in our feeding experiments are: *Hepsetia balabacensis* (locally known as *guno*), *Hemiramphus georgi*[2] (*cansusuit*), *Ambassis buruensis* (*lañgaray*), *Mugil* sp. (*talilong*), *Arius manillensis* (*kanduli*), and *Clarias batrachus* Bloch, all of which are marine forms, according to Doctor Villadolid, ichthyologist of the Bureau of Science, Manila, who identified them. However, the two last-named forms are known to spend a considerable period of their life in fresh waters. As our supply of fish was obtained regularly throughout our experiments from the different public markets of Manila, we are not in a position to state the localities from which they were caught.

Before examination the fish were washed in tap water and rinsed in physiological salt solution. The whole fish when small, or a portion of it when too large, was placed in a small petri dish and physiological salt solution added. Under a dissecting microscope the tissues were searched for metacercariæ by teasing them out bit by bit with teasing needles. Each fish was searched out in its entirety for metacercariæ—fins, scales, skin, flesh, cavities, and internal organs were scrutinized. Thus it was possible at the end of some time to determine for each species of fish the sites usually infected by metacercariæ.

By means of a fine pipette provided with a rubber nipple the metacercariæ were picked out from the dissecting dish and placed in a small quantity of physiological salt solution contained in a staining dish for subsequent feeding, or placed directly in the mouth of the experimental animal selected for the purpose. This method of feeding by pipette was used in feeding rats and mice. In the case of cats and dogs the fish was simply served to them entire or chopped.

[2] January 19, 1937. Eleven specimens of *Hemiramphus georgi* examined for metacercariæ showed in their intestines a characteristic human-fæces-like material rich in *Ascaris* and *Trichuris* eggs. This fish is well-known among the natives as a great scavenger, particularly on human fæces.

By previous tests we have found that albino rats and mice allow full development of heterophyid flukes in their intestines. Since these animals are naturally free from heterophyid infection and can be reared in the laboratory, they are quite satisfactory for feeding experiments. Young pups and kittens were also utilized for the purpose with appropriate parallel controls. Only metacercariæ obtained from one species of fish were fed to one animal. The animals were fed on metacercariæ every day or at irregular intervals, depending on circumstances, over longer or shorter periods. All the animals were kept separately in metal cages set far apart, and precautions taken against all possible contamination of their rations. Their fæces were regularly examined before the start of the experiment to insure freedom from previous heterophyid infection as well as during the progress of the experiment, to ascertain its ultimate supervention in the animals concerned. Then the animals were sacrificed, and the gastro-intestinal tract and all other organs examined for flukes.

RESULTS

The results of our feeding experiments are given separately for each species of fish used in Tables 1 to 6.

REMARKS

All the heterophyids recovered in our experiments, with the exception of *P. genata* and an immature, still unidentified, probably new heterophyid (*Microlistrum*), have already been reported from the Philippines in their final hosts. In one of the species of fish (*Ambassis buruensis*) utilized in these experiments we have frequently found two apparently different species of *Stamnosoma* (one big and having a long intestine, and the other very tiny and having a short intestine), and one *Parascocotyle* (*Phagicola*) in their metacercarial stage. The larger of the two *Stamnosoma* metacercariæ also parasitizes *Hepsetia balabacensis*, another fish used in these experiments. Up to this time, however, we have consistently failed to recover these Centrocestinæ by experimental feeding to albino rats and mice, kittens, and puppies. One of us (C. M. A.) recovered an apparently new species of *Stamnosoma* from the intestine of a pelican (*Pyrreroides manilensis*) and from the cattle egret.

It will be of interest to mention here that *Diorchitrema pseudocirrata* figured among the flukes whose eggs have been

TABLE 1.—*Feeding experiments with metacercariæ from Hespetia balabacensis (guno).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Rat 1	January 8–February 11	10	February 12	*Stictodora guerreroi* *Stictodora manilensis* *Monorchotrema calderoni*	14
Rat 2	March 25–April 23	22	April 27		0
Mouse 1	February 18–February 26	4	March 2		0
Mouse 2	February 18–February 24	4	February 28	*Stictodora guerreroi*	8
Mouse 3	April 26	1	April 30	*Stictodora guerreroi*	1
Mouse 4	April 29	1	May 2	*Stictodora guerreroi*	5
Mouse 5	May 3–July 15	19	July 15	*Stictodora manilensis*	2
Puppy 1	May 26–May 28	3	May 29	*Stictodora guerreroi* *Stictodora manilensis*	20
Puppy 2	May 29–June 5	6	June 7	*Stictodora guerreroi* *Stictodora manilensis*	94
Puppy 3	June 7–June 22	11	June 24	*Stictodora guerreroi* *Stictodora manilensis* *Monorchotrema calderoni*	214
Puppy 4	June 24–September 7	41	September 10	*Heterophyes expectans* *Stictodora guerreroi* *Stictodora manilensis*	(a)
Control Puppy 1		0	June 17		0
Control Puppy 2		0	June 22		0
Control Puppy 3		0	July 4		0
Control Puppy 4		0	September 10		0

[a] Heavy infection.

TABLE 2.—*Feeding experiments with metacercariæ from Hemiramphus georgi (cansusuit).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Rat 1	January 9–February 12	12	February 13	*Stictodora guerreroi*	92
Rat 2	March 22–April 23	20	April 24		0
Mouse 1	February 17–February 18	2	February 26		0
Mouse 2	March 2–March 4	3	March 5	*Stictodora guerreroi*	32
Mouse 3	March 4	1	March 12		0
Mouse 4	March 8–March 12	2	March 15	*Stictodora guerreroi*	3
Mouse 5	April 26	1	April 27	*Stictodora guerreroi*	7
Mouse 6	May 18–May 24	3	May 25		0
Cat 1	May 14–May 17	2	May 18	*Stictodora guerreroi*	384
Cat 2	May 26–June 5	9	June 9	*Stictodora guerreroi* *Heterophyes expectans* *Monorchotrema yokogawai*	100
Cat 3	May 28–June 14	13	June 19	*Stictodora guerreroi* *Heterophyes expectans*	482
Puppy 1	June 9–June 19	6	June 22	*Stictodora guerreroi* *Heterophyes expectans* *Monorchotrema yokogawai* *Monorchotrema calderoni*	1,680
Puppy 2	June 25–August 17	27	August 19	*Stictodora guerreroi* *Heterophyes expectans* *Monorchotrema calderoni*	(a)
Control Puppy 1		0	June 24		0
Control Puppy 2		0	July 4		0
Control Puppy 3		0	September 10		0
Control Cat		0	June 7		0

[a] Heavy infection.

TABLE 3.—*Feeding experiments with metacercariæ from Ambassis buruensis (lañgaray).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Mouse 1	January 25–February 11	10	February 15	*Stictodora guerreroi* *Stictodora manilensis* *Monorchotrema yokogawai*	33
Mouse 2	March 1	1	March 4		0
Mouse 3	March 1	1	March 2	*Stictodora manilensis*	2
Mouse 4	March 4–March 10	4	March 11	*Stictodora manilensis*	3
Mouse 5	March 11–March 15	4	March 16		0
Mouse 6	April 26	1	April 28	*Stictodora guerreroi* *Stictodora manilensis*	7
Mouse 7	April 28	1	May 1		0
Mouse 8	April 28	1	May 2		0
Mouse 9	May 3–May 4	2	May 6		0
Mouse 10	May 6–May 24	13	May 25	*Stictodora manilensis*	1
Mouse 11	May 12	1	May 14		0
Mouse 12	May 25–July 17	15	July 22	*Stictodora manilensis*	1
Rat 1	March 23–April 23	27	April 26		0
Rat 2	April 26–April 27	2	April 29		0
Puppy 1	May 26–June 16	16	June 17	*Stictodora guerreroi* *Stictodora manilensis* *Monorchotrema calderoni* *Monorchotrema yokogawai* *Heterophyes expectans*	(a)
Puppy 2	June 17–June 23	3	June 24	*Stictodora guerreroi* *Stictodora manilensis*	7

Cat 1	June 8–September 7	58	September 8	*Stictodora manilensis* *Monorchotrema yokogawai* *Stictodora guerreroi* *Monorchotrema calderoni* *Heterophyes expectans* *Microlistrum* (?) (immature)	228
Control Puppy 1		0	May 29		0
Control Puppy 2		0	July 4		0
Control Puppy 3		0	September 10		0
Control Cat		0	September 17		0

[a] Heavy infection.

TABLE 4.—*Feeding experiments with metacercariæ from Mugil sp. (talilong).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Puppy	July 10–July 27	14	July 28	*Stictodora guerreroi* *Stictodora manilensis* *Monorchotrema yokogawai* *Monorchotrema calderoni* *Diorchitrema pseudocirrata* *Heterophyes expectans* *Pygidiopsis genata* *Pygidiopsis marivillai*	3,949
Control Puppy		0	July 18		0

TABLE 5.—*Feeding experiments with metacercariæ from Clarias batrachus (hito).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Puppy	July 17–August 17	22	August 18	*Monorchotrema yokogawai*	1,815
Control puppy		0	July 18		0

TABLE 6.—*Feeding experiments with metacercariæ from Arius manillensis (kanduli).*

Experimental animal.	Dates of feeding.	No. of feedings.	Date of dissection.	Species of heterophyids identified.	No. of flukes recovered.
	1937		1937		
Puppy	August 18–September 4	11	September 13	*Monorchotrema yokogawai*	246
Control puppy			September 10		0

found by Africa et al.(3, 4, 6) in the myocardium and valves of persons dying of heart failure; and that *Monorchotrema yokogawai* has been lately found by the same authors infecting man(8) under identical conditions.

SUMMARY

1. Piscine intermediate hosts have been determined for *Stictodora guerreroi, S. manilensis, Monorchotrema calderoni, M. yokogawai, Diorchitrema pseudocirrata, Heterophyes expectans, Pygidiopsis marivillai, P. genata,* and a *Microlistrum* sp., as shown in Table 7.

TABLE 7.—*Piscine hosts of some species of heterophyids.*

Heterophyid.	*Hepsetia balabacensis.*	*Hemiramphus georgi.*	*Ambassis buruensis.*	*Mugil* sp.	*Clarias batrachus.*	*Arius manillensis.*
Stictodora guerreroi	+	+	+	+	—	—
Stictodora manilensis	+	—	+	+	—	—
Monorchotrema calderoni	+	+	+	+	—	—
Monorchotrema yokogawai [a]	—	+	+	+	+	+
Diorchitrema pseudocirrata	—	—	—	+	—	—
Heterophyes expectans	+	+	+	+	—	—
Pygidiopsis genata	—	—	—	+	—	—
Pygidiopsis marivillai	—	—	—	+	—	—
Microlistrum sp.	—	—	+	—	—	—

[a] After a critical review of the various members of the subfamily Haplorchinæ, Chen (1936) agreed with the views of Witenberg (1929, 1930) that the subfamily Monorchotreminæ and the genus *Monorchotrema* should fall into synonymy with the subfamily Haplorchinæ and the genus *Haplorchis,* respectively. According to Chen's reclassification of the members of the subfamily, *Monorchotrema yokogawai* Katsuta, 1932, should now be called *Haplorchis yokogawai* (Katsuta, 1932). Likewise *Monorchotrema calderóni* Africa and Garcia, 1935, would become *Haplorchis calderoni* (Africa and Garcia, 1935).

2. Cats, and especially dogs, are more satisfactory experimental hosts than albino rats and mice for the rearing of heterophyids.

3. The experiments give an idea of the richness of Philippine marine fishes in heterophyid metacercariæ.

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OYSTER FARMING

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THREE PLATES AND ONE TEXT FIGURE

The average yearly importation of fish and fish products into the Philippines is 2,007,409 pesos. Of this amount nearly 300,000 pesos is paid for imported oysters and shell fish. To cut down this importation, and to furnish the people with adequate information on proper and effective methods of oyster propagation, experimental plots for oyster culture by modern methods were put up in May, 1935, by Mr. Florencio Talavera, then of the Bureau of Science, at Binacayan, Kawit, Cavite Province.

Oyster farming is the most important occupation of the people of this region. Natural oyster beds are located in Bacoor Bay, so that oyster shell as well as oyster spats are readily available. The results reported in this paper of the work carried on there are very encouraging.

There are twenty-three known species of oysters in the Philippines. Those of economic importance are: *Ostrea iredalei* Faustino, *Ostrea malabonensis* Faustino, *Ostrea palmipes* Sowerby, *Ostrea cucullata* Born, *Ostrea crista galli* Linnæus, and *Ostrea glomerata* Gould. Among these six species, *Ostrea iredalei* appears to be best for commercial oyster propagation.

HABITAT AND HABITS OF OYSTERS

Oysters thrive best in brackish water. They usually grow in clusters attached to the stumps and fallen branches of trees, rocks, stakes, walls of fishponds, foundations of bridges, landings, and piers. Some are found growing on old shells scattered on or imbedded in very soft muddy bottoms of tide flats, swamps, estuaries, fishponds, and shallow water.

The food of oysters consists of microörganisms suspended in water. The oyster obtains its food by drawing in slow currents of water between the valves to the gills. The minute gill filaments strain the microscopic organisms from the water and pass them by ciliary action to the mouth, which lies between the fleshy palps near the hinge of the valves.

Oysters spawn at water temperatures ranging from 20° to 27°C. Their eggs develop into free-swimming larvæ in less than twenty-four hours after fertilization. The larvæ spend a few days among other organisms of the plankton on the upper surface of the water. This stage in their life is most critical, as many of them are caught for food by bigger aquatic animals, mostly fishes, and many more die due to unfavorable environmental conditions. Those that survive, however, settle down as spats, due to the increasing weight of the developing shell, and attach themselves to any hard object they happen upon. This period is the beginning of the sedentary life of oysters, when they are known to oystermen as "oyster seeds," or simply "seeds."

SITES SUITABLE FOR OYSTER FARMING

The best sites for oyster farming are tidal rivers, narrow creeks, salt marshes, and land-locked bays. The prevailing bottom among them is hard and sticky mud, best fitted for oyster culture. They are protected from the rough sea, and the water is often rich in plankton organisms which constitute the food of oysters.

Oysters also grow in some localities in the sounds, but it would be unwise to cultivate them there on a commercial scale. Sounds with sandy and shifting bottoms are unfit for oyster propagation, because they are exposed to heavy seas, and the salinity of the water is high.

Although oysters grow in the mouths of rivers, these are not suitable sites for oyster cultivation. Oysters growing at the mouths of rivers are exposed to water of low salinity, especially at freshets, and to strong currents, especially during the rainy season, and they are subject to heavy deposition of silt which causes their wholesale destruction.

METHODS OF OYSTER CULTIVATION

Local methods.—Only two methods of oyster cultivation are known to the local oystermen: Spreading of old oyster shells, and the *tulus* method.

Old shells from uncooked oysters are scattered on the places where oysters are found growing. These shells are preferred because of the mistaken notion that spats do not attach themselves to shells taken from cooked oysters. Some oystermen also believe that young oysters develop out of the old oyster shells which are scattered over the oyster ground. This method of

oyster culture is extensively practiced by oystermen in Navotas and Malabon, Rizal Province, and Binuañgan, Obando, and Paombong, Bulacan Province.

Oyster propagation through this method usually results in small harvest, if not in complete loss. The planted old oyster shells are often buried under the sand or mud, or carried away by the tides, currents, and waves, so that very few remain for collecting spats. Oyster shells with spats attached and buried into the mud or sand cannot produce oysters for harvest, because spats attached to them die of suffocation. Oysters grown on the surface of mud are generally thin. Oftentimes they become unfit for human consumption because the debris from the mud is taken into their bodies.

Found oftentimes attached to bamboo stakes or *tulus* used for strengthening the *baklad* are clusters of oyster shells. This observation of *baklad* owners led to the use of bamboo stakes for catching and growing oysters. Thus in some localities oyster spats are collected and grown on bamboo branches and trunks implanted in intertidal areas. This method is known as the *tulus* method of oyster culture.

Modern methods.—Oyster cultivation along modern lines consists of two steps: Spat collecting, and growing the seeds into marketable size.

Collecting of spats has been the subject of various experiments in foreign countries. The most common among the types of spat collectors tested were the wire bags filled with oysters, scallop, and clam shells; fascine collectors of twigs and branches of trees; round galvanized wire bushel baskets filled with clam, mussel, and oyster shells; bamboo and wooden screens; tarred cables or ropes; oyster shells threaded on wires; and the partition type of spat collector made from ordinary egg-crate partitions dipped in hot paraffin and coated with a thin layer of sand.

At the Binacayan Oyster Farm, managed by the Fish and Game Administration, Bureau of Science, all the above devices were tried, except the partition type of spat collector. Considering the great expense involved in the use of galvanized-wire bags and baskets which are costly, oyster shells threaded on wire as spat collector were tried with great success and found to suit local needs. Other types of spat collectors were also tried, among them are the following: Shells threaded on cabo-negro rope hung from fences or floats; shells threaded on round rattan of ¼ inch diameter, hung from fences or floats; rope (cabo-negro

and abacá) wound about frames and lowered in the spawning area; bamboo slats with oyster shells clipped on the edges at regular intervals and planted in the ground between tide levels; and bamboo cone-shaped baskets on poles filled with oyster shells and placed in the spawning ground. The results obtained are not as good as those obtained with the hanging spat collectors made of old oyster shells threaded on wire. At the Binacayan Oyster Farm spat collecting is done during May, June, July, and August.

The spats collected are transplanted as seeds to suitable oyster grounds, where they grow until harvested. The seeds are ready for the growing beds during August and September. In transplanting them either the stake method or the hanging method is used.

In the stake method, old oyster shells with attached seeds are impaled on the sides of bamboo stakes 3 to 4 feet long. The stakes with five to ten shells arranged on each at intervals are planted on the tideflats. Oyster seeds attached to the impaled shells are left to grow until harvested.

In the hanging method, six or seven oyster shells with attached seeds are threaded on a wire 70 cm long. The shells are separated from each other by bamboo or *usiw* tubes 10 cm long. Several of these wires strung with shells are then suspended on bamboo railings supported by bamboo trunks or *puno*, which are grouped into plots. Hanging collectors with seeds may also be suspended on floats or rafts of bamboo.

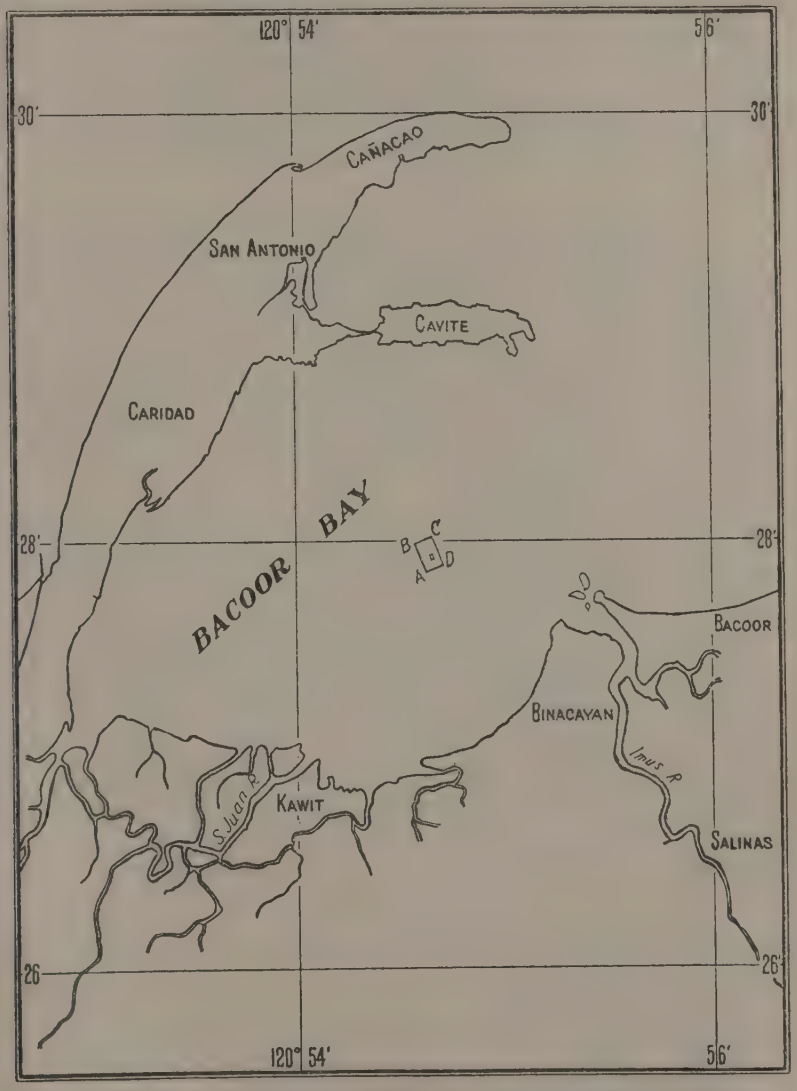
According to the oystermen of Binacayan, Kawit, Cavite Province, who are practicing the modern method of oyster cultivation, their harvest of oysters has more than doubled since they abandoned the old methods of oyster culture. With the modern method oyster seeds grow fast, for they have free access to food on all sides, besides being free from the harmful effects of mud and grains of sand.

Oysters grown by means of the hanging method are clean and fat because they are free from dirt and are constantly supplied with food by the water currents passing through the oyster beds.

HARVESTING

With the old method of oyster culture harvesting is very difficult. A man dives for the oysters and takes them from the surface of the mud. He carries a wire basket for holding the catch which is transferred into a boat from time to time.

Usually a whole day is spent in collecting enough oysters to fill a banca with a capacity of five *kaings*.



Sketch of Bacoor Bay, showing the position of the Bureau of Science Oyster Farm.

Oysters are ready for harvest seven months after the time the spats are collected up to the time the seeds are transplanted to the oyster beds for growing. At the Binacayan Oyster Farm

the spats collected and planted during May, June, July, and August are harvested during December, January, February, and March, respectively.

Harvesting of oysters raised by the hanging method is very easy. A man rows his boat between the oyster plots, and with the help of a pair of pliers he unfastens the clusters of oysters hanging from the bamboo railings. A boat with a capacity of five kaings can easily be loaded within thirty minutes.

A MODEL OYSTER FARM

A one-hectare farm may be taken as a model to demonstrate the practicability of the hanging method of oyster culture. According to the Bureau of Science plan there are 220 units of platforms or fences. Each unit, 1.20 meters wide and 24 meters long, has 5 long rows 30 cm apart, supported on 63 bamboo trunks. These rows are set in three parallel lines 60 cm apart with 21 posts to the line and 21 crosspieces. Each of these pieces is 1.50 meters long. There are two side alleys 50 cm wide and two 60 cm wide.

The number of bamboo posts 3 to 5 meters long needed for the 220 units is 13,860. The collectors that can be hung at 30 cm intervals number 89,100 and require 446 rolls of 35-lb G. I. wire No. 8, cut into lengths of 70 cm, so that no less than 200 short pieces can be cut from each roll. For railings and crosspieces 2,400 bamboos 12 feet long will be sufficient. For the hanging of the collectors 360 kilos of ordinary 2½-inch nails are required, and for the crosspieces 100 kilos of ordinary 3-inch nails. About 600 kaings of dead oyster shells and about 300,000 bamboo or usiw tubes, 10 to 15 cm long and 3 to 5 cm in diameter, are needed.

DATA ON THE COMMERCIAL POSSIBILITIES IN AN OYSTER-CULTURE PROJECT IN 1 HECTARE

	Pesos.[a]
I. *Probable initial capitalization:*	
a. Materials and Supplies (list A)	3,347.60
b. Labor (list B)	400.00
c. Working capital	250.00
Total	3,997.60
II. *Probable expenses (annual):*	
a. Maintenance:	
1. Wages (1 laborer at 30 pesos a month)	360.00

[a] One peso equals 50 cents United States currency.

	Pesos.
2. Cost of materials and supplies for repair (list C)	765.10
b. Fixed charges:	
1. Interest on capital, 10 per cent	399.76
c. Sales charges:	
1. Sales tax, 1.5 per cent of sales	45.00
2. Harvesting, advertising, and marketing, 12 per cent of selling price	356.40
Total	1,926.26
III. *Probable income (annual)*:	
a. Sale of 5,940 kaings of oysters (harvest from 89,100 collectors, calculating on 1 kaing from 15 collectors) at 50 centavos	2,970.00 [b]
b. Operating expenses (Item II)	1,926.26
	1,043.74
IV. *Probable net income (deducting b from a in III)*: 1,043.74 pesos, or 26.1 per cent of the total capitalization.	

COST OF CONSTRUCTING A 1-HECTARE FARM

	Pesos.
A. *Materials and supplies (list A)*:	
1 nipa house	150.00
13,860 bamboo trunks (puno for posts, 8 centavos each)	1,108.80
2,400 bamboos 12 ft. long, 30 centavos each	720.00
446 rolls 35-lb No. 8 G. I. wire, 1.70 pesos each	728.20
360 kilos ordinary 2½-inch nails, 11 centavos per kilo	39.60
100 kilos ordinary 3-inch nails, 11 centavos per kilo	11.00
600 kaing old oyster shells, 15 centavos a kaing	90.00
300,000 usiw tubes (bungbong)	60.00
2 hammers	2.40
1 saw	3.40
2 pairs of pliers	2.20
40 kaings	12.00
2 bancas	120.00
1 outboard motor	300.00
Total	3,347.60
B. *Labor (list B)*:	
20 men to finish 220 plots in 25 days, 80 centavos per man per day	400.00

[a] One peso equals 50 cents United States currency.

[b] The current price for 1 kaing of oysters is 80 centavos to 1.20 pesos.

C. *Materials and supplies for repairs (list C):*	Pesos.
1,000 bamboo trunks (puno), 8 centavos each	80.00
500 bamboos 12 ft. long, 30 centavos each	150.00
200 rolls 35-lb. No. 8 G. I. wire, 1.70 pesos each	340.00
360 kilos ordinary 2½-inch nails, 11 centavos a kilo	39.60
600 kaings old oyster shells, 15 centavos a kaing	90.00
300,000 usiw tubes (bungbong)	60.00
50 kilos ordinary 3-inch nails, 11 centavos a kilo	5.50
Total	765.10

ILLUSTRATIONS

PLATE 1.

PLATE 2.

PLATE 3.

CHIRONOMIDÆ FROM JAPAN (DIPTERA), X

NEW OF LITTLE-KNOWN MIDGES, WITH DESCRIPTIONS OF THE METAMORPHOSES OF SEVERAL SPECIES [1]

By Masaaki Tokunaga

Of the Entomological Laboratory, Kyoto Imperial University, Japan

FORTY-FOUR TEXT FIGURES

The midges of the Chironomidæ discussed herein were collected chiefly by myself in Honshu and Kyushu. A second important series was collected in Formosa by Dr. Ryoichi Takahashi. A few additional species were collected elsewhere by Drs. Hachiro Yuasa and Yaichiro Okada, and Messrs. Yasuji Yamada, Tokichi Kani, Tadao Masuda, and Kazuo Shibuya. My sincere thanks are extended to the above-mentioned zoölogists who have thus contributed to the further study of the Japanese Chironomidæ.

Of the midges dealt with in the text, the following three species are peculiar in habitat, being found in hot springs of mineral water in their immature stages: *Pentaneura okadai*, *Chironomus lugubris*, and *Tanytarsus uraiensis*. Another interesting midge is *Clunio takahashii*, the first marine midge from Formosa, found in the tidal zone of a rocky shore, and representing the sixth species of the genus. Another important species is *Spaniotoma akamusi*. The blood-red larvæ of this species are well-known bait for anglers, being known as *akamusi*, especially for the following fresh-water fishes in Kyoto and Osaka: *Gnathopogon cærulescens*, *Zacco platypus*, and *Carassius auratus*.

The morphological terminology used in the text is based on previous papers of this series. The antennal ratio is the ratio between the length of the ultimate segment and the combined length of the remaining segments, except the scape, and, in the case of the male of the Tanypodinæ, between the length of the ultimate two segments and the combined length of the remaining segments, except the scape. The leg ratio is the ratio of the length of the first tarsal segment of the leg to that of the tibia.

[1] Contribution from the Entomological Laboratory, Kyoto Imperial University, No. 64.

The abbreviations of the wing venation used in the present paper are those used in text figures 3 and 4.

CLUNIONINÆ

CLUNIO TAKAHASHII sp. nov.

This marine midge is quite peculiar in the highly reduced male antennal segments. The female and immature stages are still unknown.

Male.—Body length 1.3 to 1.5 millimeters; ground color brown.

Head uniformly brown, with antennæ mainly white, maxillary palpi yellowish brown. Antenna (text fig. 1, *a*) 7-segmented (20 : 38 : 14 : 13 : 13 : 14 : 100), with antennaria and scape somewhat brownish, intermediate flagellar segments brownish

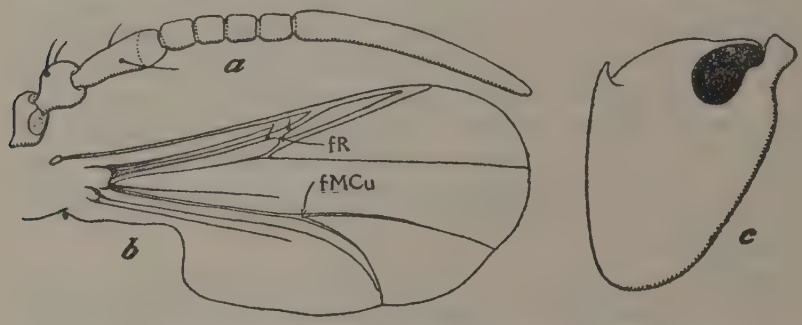


FIG. 1. *Clunio takahashii* sp. nov. (male). *a*, Antenna; *b*, wing; *c*, style.

at each distal end, ultimate segment slender; antennal ratio about 1.1 (16 : 14). Thorax brown in ground color; scutum with dark-brown middorsal line or pale-brown median vitta; caudoscutal area with paired short yellow stripes; humeral parts dark brown; pseudo-sutural foveæ each with four or five small setæ; supra-alar setæ three; scutellum yellowish brown. Legs mainly white; coxæ, trochanters, bases of femora, knee joints, and distal ends of tarsal segments of all legs brown; tibial spur only one on each leg, almost straight; claws distinctly curved; empodium very large. Proportional lengths of segments of legs, excepting coxæ and trochanters 19 : 26.5 : 6 : 2 : 2 : 2 : 3 in foreleg, 24 : 23 : 3 : 2 : 1.8 : 1.4 : 3 in middle leg, and 26 : 26 : 4 : 1.7 : 3 : 1.5 : 3 in hind leg. Wing (text fig. 1, *b*) milky white by reflected light and pale brown by transmitted light, with narrow base; macrotrichia very sparse even on the veins. Venation: R_1 ending at middle of costal margin; Rs straight, about thrice as long

as R_1, subequal to radial stem; M_{1+2} straight, reaching wing margin; base of fork between M_{4+5} and Cu_1 just beyond base of radial fork; M_{4+5} and Cu_1 gently curved, reaching wing margin; Cu_2 complete, ending on Cu_1; 1st A hardly reaching under fork between M_{3+4} and Cu_1. Halteres white. Abdomen brown; hypopygium very large, turned through about 180°; style (text fig. 1, *c*) large, triangular, nonsetigerous, with a sharp spine at ventral corner, without apical spines.

Habitat.—Seashore, Formosa.

Holotype.—Male; Tansui, near Taihoku; January 1, 1935.

Paratopotypes.—Two males; January 3, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. R. Takahashi.

This species is named in honor of the collector, Dr. Ryoichi Takahashi. The present midge is quite specific in the 7-segmented antennæ, distinctly petiolate wings, and characteristic wing venation. It may be noteworthy that all other known species of the genus *Clunio* are provided with 10-segmented antennæ in the male.

TANYPODINÆ

PENTANEURA OKADAI sp. nov.

The present species is white in ground color, with four distinct reddish brown vittæ on the scutum; the wings are thickly covered with macrotrichia; there are no colored markings on the wing.

Male.—Body about 2.7 millimeters long, very extensively white. Head almost entirely pale brown; vertex with a brown triangular marking; eyes bare, widely separated above from each other. Antennæ uniformly pale brown; antennal ratio about 0.9, always less than 1; maxillary palpus pale brown, 5-segmented (2 : 4 : 8 : 8 : 5 : 12). Thorax yellowish white; pronotum pale brown; scutum with four very distinct reddish brown vittæ; stripes between vittæ brown; shoulder parts yellowish white; caudoscutal area white; scutellum white; postscutellum brown, with a median yellowish line; pleural and sternal sclerites uniformly yellowish white. Legs entirely pale brown, without beards; claws simple; empodium vestigial, pulvilli wanting. Relative lengths of segments, except coxæ and trochanters, as follows: 37 : 43 : 31 : 16 : 12.5 : 8.5 : 6 in foreleg, 41 : 36 : 27 : 11 : 8 : 6 : 5 in middle leg, and 37 : 48 : 37 : 19 : 14 : 9 : 6 in hind leg. Wing (text fig. 2, *a*) with macrotrichia thickly spread over entire surface, without colored markings. Venation: Costa

produced beyond end of R_{4+5}; R_{4+5} ending on costa on the level of end of M_{3+4}; relative lengths of R_1 and R_{4+5} 22 : 39; R_{2+3} simple, extending closely along R_{4+5}, atrophied on distal part; m-cu very short. Halteres whitish yellow. Abdomen very extensively white; terga from second to seventh segment each with a T-shaped whitish pale-brown marking on cephalic part; hypopygium (text fig. 2, *b*) pale brown; coxite with a blunt swelling on mesal side; style straight, about three-fourths as long as coxite, pubescent on basal half, tapering on distal half, with a strong brown spine.

Female.—Body about 1.5 millimeters long; coloration as in male. Antenna (text fig. 2, *c*) 12-segmented, with a slender

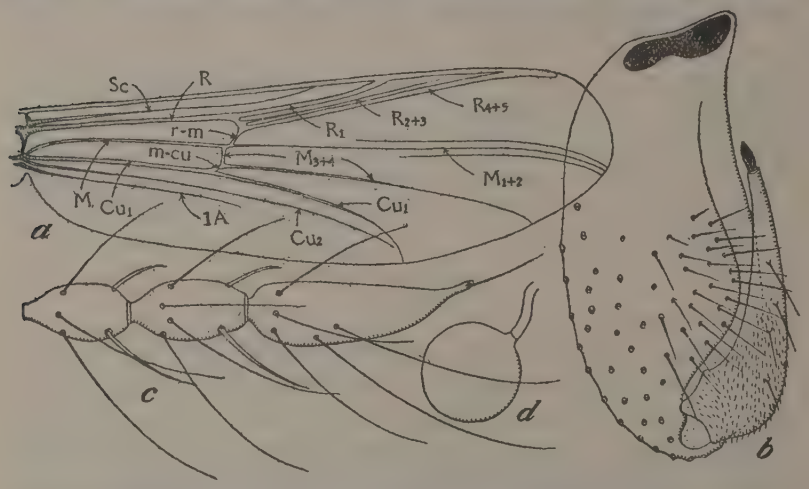


FIG. 2. *Pentanecura okadai* sp. nov. *a*, Male wing (macrotrichia omitted); *b*, male hypopygium; *c*, distal segments of female antenna; *d*, spermatheca.

terminal projection and an apical seta; proportional lengths of distal four segments 14 : 14.3 : 15.7 : 30.7; antennal ratio 0.2. Palpus 5-segmented (2 : 4 : 7 : 8 : 12). Proportional lengths of segments of middle leg 41 : 38 : 24 : 10 : 7.5 : 5.5 : 4.5. Wing with costa less produced than in male; relative lengths of R_1 and R_{4+5} 21 : 45. Abdomen entirely white; spermathecæ (text fig. 2, *d*) three, spherical, yellow; cercus triangular.

Habitat.—Hot spring of mineral water; Honshu, Japan.

Holotype.—Male; Yuno-Mine-Onsen, Wakayama Prefecture. March 24, 1937.

Allotopotype.—Female; March 24, 1937.

Paratopotypes.—Many males and females; March 24, 1937.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. Yaichiro Okada.

The present species is named in honor of the collector, Dr. Y. Okada. This fly is closely allied to *P. cigulata* Walker and *P. kyotoensis* Tokunaga. In the former species, however, the abdomen is extensively brown, with a paler narrow band on the caudal margin of each tergum, and the antennal ratio is about 1.25. In the latter species the pleural side of the thorax carries dark spots, the antennal ratio is greater than 1, and the costa is not produced beyond the end of R_{4+5}.

ORTHOCLADIINÆ

SPANIOTOMA (ORTHOCLADIUS) AKAMUSI sp. nov.

This species is a famous bait for minnow angling in Osaka and Kyoto, as I reported in 1935. The emergence of imagines occurs once a year, during September and October.

Male.—Body about 8 to 9.5 millimeters long, black in ground color. Head entirely black; antennæ black, with dark plumose hairs, 14-segmented; antennal ratio about 2.7 to 3; palpus black, 5-segmented (2 : 5 : 10 : 10 : 13); eyes bare. Thoracic ground color black, highly pruinose in brown along foveæ, slightly pruinose on vittæ, with a pair of black shining humeral thickenings; thoracic setæ brown, slender. Legs with coxæ dark brown; trochanters brown; femora brown, broadly black on distal part; tibiæ black, broadly brownish at middle; tarsus black; empodium minute; no pulvilli; first and second tarsal segments of middle and hind legs with apical spurs; foreleg without beards. Relative lengths of segments of foreleg 94 : 115 : 86 : 51 : 37 : 25 : 19, those of middle leg 106 : 111 : 55 : 34 : 26 : 18 : 18, and those of hind leg 114 : 129 : 68 : 43 : 34 : 20 : 18. Wing (text fig. 3, *a*) gray by transmitted light, squama brown; radial stem, and basal half of R_1 and R_{2+3} yellowish brown; costa, M, R_{4+5}, base of R_{2+3} and r-m black; costa produced beyond end of R_{4+5}; R_{4+5} straight; R_{2+3} ending just beyond middle between ends of R_1 and R_{4+5}. Halteres dark brown, with stems brown. Abdomen black; hypopygium (text fig. 3, *b*) dark brown, without thickened anal point; dorsoproximal appendage dark brown, chitinized, bare on apical half; ventral appendage pale brown, pubescent; styles characteristic in structure, each with a large flattened lobe.

Female.—Size and coloration as in male. Antenna with scape brown, pedicel yellow, 7-segmented (6 : 6 : 6 : 6.5 : 6 : 6 : 14.5);

palpus with first segment brown, 5-segmented (2 : 5 : 10 : 8 : 12). Relative lengths of segments of legs 95 : 125 : 87 : 51 : 36 : 25 : 20 in foreleg, 109 : 120 : 58 : 33 : 25 : 19 : 18 in middle leg, and 120 : 142 : 78 : 47 : 36 : 20 : 18 in hind leg. Wing comparatively broad, with anal lobe almost right-angled. Cercus (text fig. 3, *c*) black, earlike; spermathecæ (text fig. 3, *d*) three, equal, dark brown, with colorless hyaline neck region.

Habitat.—Stagnant water; Honshu, Japan.

Holotype.—Male; Osaka; October, 1936.

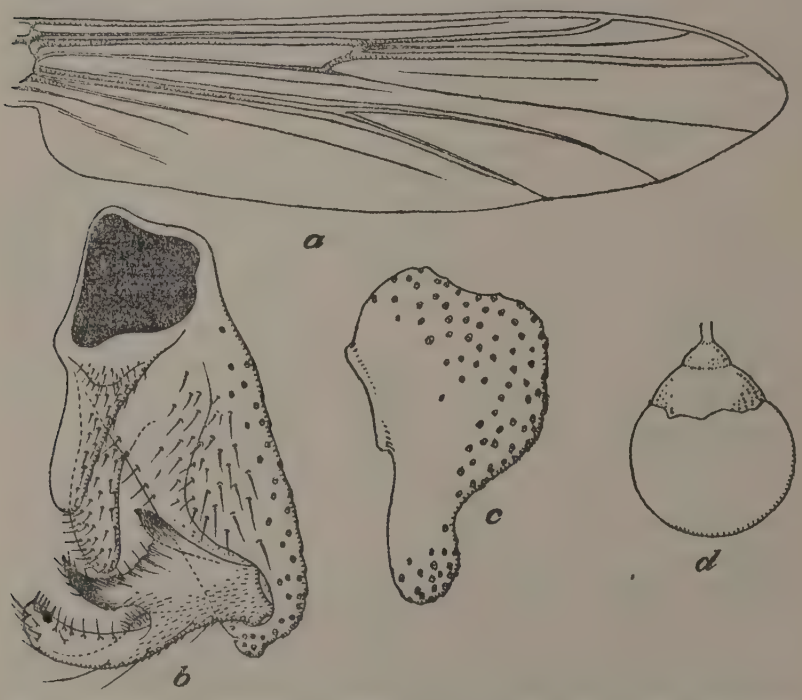


FIG. 3. *Spaniotoma* (*Orthocladius*) *akamusi* sp. nov. *a*, Male wing; *b*, male hypopygium; *c*, female cercus; *d*, spermatheca.

Allotopotype.—Female; October, 1936.

Paratopotypes.—Males and females; October, 1936.

Type specimens.—Alcoholic egg masses, larvæ, pupæ, and imagines; deposited in the entomological laboratory, Kyoto Imperial University; collected and reared by Mr. Atsuo Tanaka and M. Tokunaga.

This species is quite characteristic in the structure of the male styles.

SPANIOTOMA (TRICHOCLADIUS) CHALYBEATA Edwards.

This species is characteristic in thoracic coloration, the scutum being shining black and having a pair of distinct yellow spots on the humeral parts, as stated by Dr. F. W. Edwards. This midge is very abundant in Kyoto along a margin of still water in autumn.

Male.—Body about 2.5 millimeters long; antennal ratio about 1.2 (26 : 22); nonplumose apical area of antenna pubescent on distal half; maxillary palpus with four distinct segments (3 : 5 : 8 : 12); foreleg with following proportional lengths of segments 37 : 45 : 27 : 17 : 13 : 9 : 6; fore tibial spur as long as diameter of tibial end.

Female.—Body about 2 millimeters long; antenna 6-segmented (17 : 22 : 14 : 15 : 14 : 38); intermediate flagellar segments each with a short neck region; ultimate segment without long setæ; maxillary palpus distinctly 4-segmented (3 : 4.5 : 7 : 9); legs black or dark brown, with trochanters and bases of femora yellowish brown. Proportional lengths of foreleg 35 : 42 : 24 : 14 : 11 : 8 : 6; cercus (text fig. 4, *a*) with a ventral projection; spermathecæ (text fig. 4, *b*), hyaline, large, oval, each with a neck region. Other characters of male and female as stated by Doctor Edwards (1926).

FIG. 4. *Spaniotoma* (*Trichocladius*) *chalybeata* Edwards. *a*, Female cercus; *b*, spermatheca.

Habitat.—Stagnant water.

Specimens.—Alcoholic males and females; Ikeda, Osaka; July 30, 1935; Kitashirakawa, Kyoto; October 19, 1935; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. K. Shibuya from a nest of a hunting wasp, *Crabro wesmäeli* v. d. Linden, and by M. Tokunaga.

SPANIOTOMA (EUKIEFFERIELLA) BICOLOR Zetterstedt.

In this species the sexes are distinguished by color, the male being black and the female extensively yellow.

Male.—Body length about 2 millimeters; ground color black; antennæ with white plumose hairs; wings milky white. Head with eyes widely separated above, distance between them twice their vertical lengths; antenna 14-segmented; nonplumose apical part swollen distally, with small hairs on distal half; antennal ratio less than 1 (21.5 : 23); maxillary palpus distinctly 4-segmented (3 : 4 : 6 : 9). Foreleg entirely dark, proportional lengths of segments 26 : 31 : 20 : 18 : 12 : 7 : 4; middle and hind legs mainly whitish brown, femoral bases dark, tibiæ white at middle, tarsi dark; tibial spur longer than diameter of tibial end; pulvilli small, half as long as claws; empodium slender, as long as claws. Wing (text fig. 5, *a*) milky white, with veins white; squama with a single seta, costa produced beyond end of R_{4+5}; R_1 about half as long as R_{4+5}; R_{2+3} closely extending along R_{4+5}; R_{4+5} almost straight, ending before level of end of

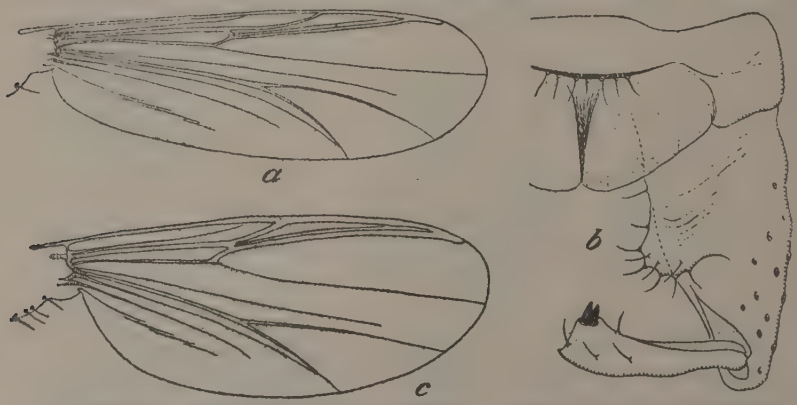


FIG. 5. *Spaniotoma* (*Eukiefferiella*) *bicolor* Zetterstedt. *a*, Male wing; *b*, male hypopygium; *c*, female wing.

M_{4+5}; fMCu beyond the crossvein. Abdomen including hypopygium black; ultimate tergum (text fig. 5, *b*) with a needlelike anal point, slightly setigerous along a transverse thickening; coxite with a small mesal lobe; style truncate with two apical spines.

Female.—Body about 1.7 millimeters long; ground color yellow. Head with vertex black; antenna with ultimate segment dark, 6-segmented (2.5 : 3 : 2 : 2 : 2 : 5.3); maxillary palpus 4-segmented (3 : 4 : 5 : 9 : 5), dark on three proximal segments. Thorax with dark markings; scutum with three distinct black vittæ, postscutellum black; pleural side with a black longitudinal stripe on precoxal region; sternal side with a pair of dark clouds. Forelegs uniformly clouded in brown, proportional lengths of segments 22 : 28 : 16 : 11 : 7 : 5 : 4; ultimate tarsal

segments and femoral bases of middle and hind legs black; coxæ of all legs black; halteres yellow. Wing (text fig. 5, *c*) with veins R_1 and R_{4+5} somewhat swollen, brown; R_{4+5} gradually curved, about four times as long as R_1; fMCu under fR. Abdomen with terga and ultimate sternum dark brown; cerci yellow.

Specimens.—Alcoholic males and females; Kitashirakawa, Kyoto; October 23, 1935; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

CHIRONOMINÆ

PENTAPEDILUM SORDENS van der Wulp.

This species is very abundant at Tomioka, Amakusa.

Male.—Body about 3.5 millimeters long, dark brown in ground color. Head dark brown, with eyes bare, frontoclypeus setige-

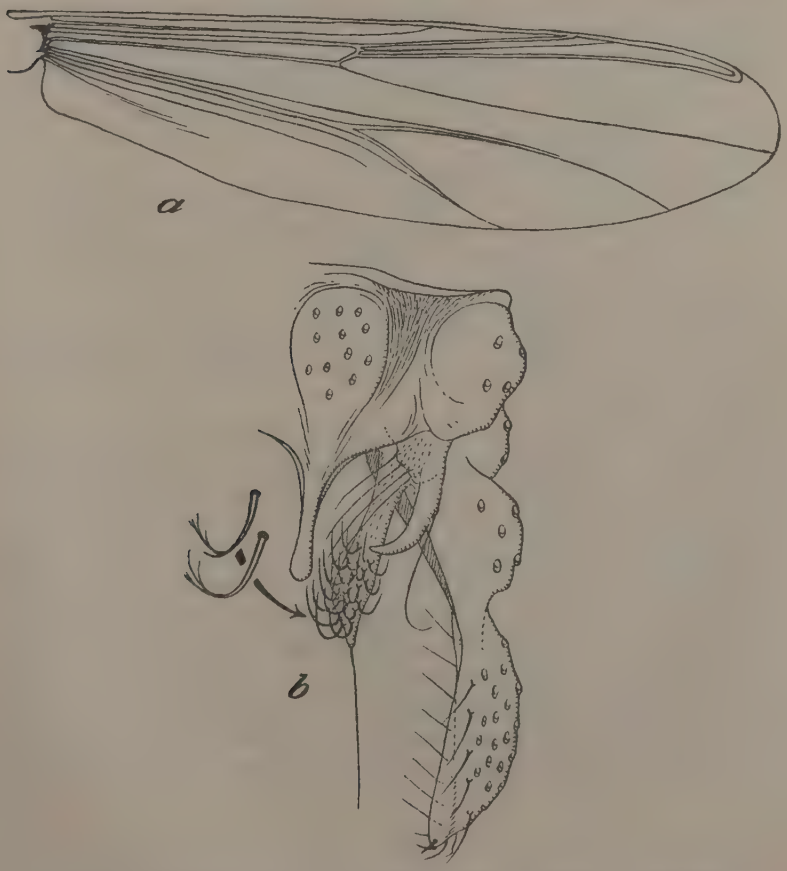


FIG. 6. *Pentapedilum sordens* van der Wulp (male). *a*, Wing; *b*, hypopygium.

rous; no frontal tubercles; antennæ 14-segmented, black; antennal ratio 1.9; maxillary palpus entirely black, 5-segmented (3 : 4 : 11 : 11 : 16.5). Thorax largely black; scutum with three distinct black vittæ which are separated by two yellowish brown pseudosutural foveæ; shoulder parts yellowish; caudoscutal area brown; scutellum yellowish brown; pleural membranes yellow. Legs almost entirely dark brown, with coxæ black; no tarsal beards; pulvilli as large as claws; fore tibia with a sharp fixed spine; middle and hind tibiæ each with two combs and one spur. Relative lengths of segments of legs 63 : 53 : 65 : 40 : 34 : 24 : 12 in foreleg, 72 : 62 : 32 : 23 : 17 : 11 : 7 in middle leg, and 75 : 70 : 44 : 26 : 24 : 15 : 8 in hind leg; foreleg ratio about 1.2. Halteres dark brown. Wing (text fig. 6, *a*) densely hairy, with minute dots spread over entire surface, membrane dark by transmitted light; veins brown; fMCu under base of Rs. Abdomen almost entirely black; each tergum narrowly pale brown along caudal margin; hypopygium (text fig. 6, *b*) with a long anal point; dorsal appendage with a bare long projection, a long isolated and several basal long setæ; ventral appendage pointed caudad, with a long apical seta and many curved setæ on apical part.

Specimens.—Alcoholic males; Tomioka, Amakusa, Kyushu; October 27, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

CHIRONOMUS (CHIRONOMUS) LUGUBRIS Zetterstedt.

Many larvæ and pupæ of the present species were found in hot springs of mineral water, about 17° to 28° C., at Mount Unzen, Kyushu.

Male.—Body about 3.5 millimeters long, black in ground color. Head black, with small frontal tubercles; eyes, frontoclypeus with many dark setæ. Antenna 12-segmented, mainly dark brown, with scape black; antennal ratio about 2.5 to 2.6; maxillary palpus black, 5-segmented (2.5 : 2.5 : 9 : 10 : 13.5). Thorax slightly shining, with brown setæ; supra-alar setæ about five or six; scutum black, with shoulder parts and caudoscutal area dark brown; scutellum black. Legs with coxæ black, trochanters and basal half of femora brownish, other parts entirely black; tarsal segments of middle leg with strong apical setæ; those of hind leg with less strong apical setæ; empodium hyaline; pulvilli dark brown; no beards. Relative lengths of seg-

ments of foreleg 66 : 54 : 77 : 39 : 32 : 25 : 15; those of middle leg 68 : 39 : 28 : 17 : 13 : 10 : 8; those of hind leg 73 : 67 : 40 : 24 : 19 : 12 : 9. Wing (text fig. 7, *a*) with veins pale brown; r-m and base of Rs brown. Halteres pale brown. Abdomen with terga brownish black; hypopygium (text fig. 7, *b*) curved dorsad, with anal point long; dorsal appendage nonpubescent, broad, with several small basal setæ.

Female.—Body about 3 to 4 millimeters long. Antenna 6-segmented (4 : 8 : 5 : 6 : 5.2 : 12.8), with scape and ultimate segment black; second segment deeply constricted at middle;

FIG. 7. *Chironomus* (*Chironomus*) *lugubris* Zetterstedt. *a*, Male wing; *b*, male hypopygium; *c*, female wing; *d*, female cercus; *e*, hooklets of second abdominal tergum of pupa; *f*, caudolateral spine of eighth abdominal segment of pupa.

intermediate flagellar segments dark brown on basal half, pale brown on neck region; ultimate segment without basal setæ; antennal ratio about 0.5; palpus dark brown, 5-segmented (2.5 : 2.5 : 8.5 : 9.5 : 14). Legs almost entirely dark brown; trochanters, basal half of femora, and middle part of tibiæ brown. Relative lengths of segments 70 : 54 : 80 : 39 : 33 : 27 : 16 in foreleg, 70 : 65 : 29 : 17 : 13 : 10 : 8.5 in middle leg, and 76 : 73 : 43 : 24 : 21 : 13 : 10 in hind leg. Wing (text fig. 7, *c*) with veins brown, r-m and base of Rs black. Abdomen dark brown, with

cerci (text fig. 7, *d*) subtriangular; spermathecæ two, oval, hyaline, colorless, with very short neck region.

Pupa.—Body about 6.5 millimeters long. Exuviæ hyaline, mainly colorless; head, thorax, and terminal end pale brown; abdominal lateral thickenings black. Head with frontal tubercles distinct, each carrying a single apical seta. Thoracic respiratory organs white, consisting of numerous filaments, as in *C. dorsalis;* thorax with a small median tubercle on dorsal side. Abdomen with lateral swimming lamellæ and long hairs on caudal segments from fifth to eighth; these long lateral swimming hairs four pairs on segments five, six, and seven, five pairs on segment eight; terga of second to fifth segments almost entirely spinulose; sixth tergum with three spinulose areas: one on anterior part and one pair on posterior part; seventh tergum without posterior spinulose areas; eighth tergum with a pair of large spinulose areas; second tergum with a caudal line of hooklets which are distinctly serrate on convex side (text fig. 7, *e*); this transverse line of hooklets distinctly interrupted at middle; caudolateral spines of eighth segment black, simple, elongated, and filamentous on apical part (text fig. 7, *f*); ultimate segment fringed with numerous lateral swimming hairs on flattened lamellæ, and a pair of long lateral isolate setæ, caudal lamellæ of male longer than basal width but in female shorter than basal width; genital sheaths of both sexes not extending caudad beyond the caudal end of ultimate segment.

Habitat.—Hot spring of mineral water; Kyushu, Japan.

Specimens.—Alcoholic egg masses, larvæ, pupæ, and male and female imagines; Mount Unzen, Nagasaki Prefecture; October 25 and 26, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

CHIRONOMUS (GLYPTOTENDIPES) GLAUCUS Meigen.

This species is very abundant in a fresh-water pond at Tomioka, Kyushu.

Male.—Body length about 5.5 to 6.5 millimeters. Head yellowish brown; frontoclypeus brown, setigerous; frontal tubercles very minute. Antennæ 12-segmented, dark brown; antennal ratio about 3.7 to 3.9; maxillary palpus black, 5-segmented (4 : 4 : 14 : 12 : 15). Dorsal side of thorax almost entirely black; prothorax yellow, highly reduced; scutum highly pruinose along foveæ, its shoulder parts obscurely yellowish; pleural membranes yellowish brown; pleural and sternal sclerites black. Legs with coxæ and trochanters brown; femora bicolored: Distal fourth of fore femur, distal half or one-third of middle

femur, and entire length or distal two-thirds of hind femur black, other parts brown; tibiæ black; tarsal segments mainly black; pulvilli large; two combs of tibia each with a spur; no beards. Relative lengths of segments of foreleg 95 : 86 : 125 : 70 : 58 : 50 : 22, those of middle leg 105 : 106 : 52 : 37 : 30 : 21 : 13, and those of hind leg 103 : 120 : 77 : 50 : 43 : 28 : 14. Wing (text fig. 8, *a*) obscurely yellowish at base, slightly clouded darkly on entire surface, with veins black; R_{4+5} straight; M_{3+4} and Cu_1 undulated. Halteres pale brown. Abdominal terga entirely black; terga from second to sixth each with a distinct median impression, which is about one-third as long as tergal length in second to fourth terga, and about half as long as tergal length in fifth and sixth terga; hypopygium (text fig. 8, *b*) dark brown, with styles broad; dorsal appendages large, nonpubescent, slightly setigerous at basal part.

Female.—Body about 7 to 9 millimeters long, coloration almost as in male. Antenna with scape yellowish brown; intermediate flagellar segments fusiform, yellowish brown on basal half and black on distal half, with neck region short; ultimate segment black; relative lengths of segments, 5 : 8 : 7 : 7.8 : 8 : 8.5 : 17; palpus 5-segmented (4 : 4 : 13 : 12 : 18). Relative lengths of segments of legs 97 : 90 : 144 : 66 : 57 : 49 : 24 in foreleg, 109 : 110 : 54 : 35 : 28 : 20 : 14 in middle leg, and 108 : 126 : 84 : 54 : 45 : 27 : 15 in hind leg. Halteres dark brown. Wing broad; R_{4+5} slightly curved along costal margin; M_{3+4} and Cu_1 not sinuous. Abdominal tergal impressions as in male, but that of fifth tergum comparatively shorter, about one-third as long as tergal length; cerci (text fig. 8, *c*) pale brown; spermathecæ (text fig. 8, *d*) two, spherical, colorless, hyaline.

Pupa.—Male about 8 to 10 millimeters long, female about 11 to 12, dark red in life, exuviæ brown; thoracic regions dark brown. Head with a pair of distinct tubercles each with an apical seta. Thoracic respiratory organ 5-branched at base, consisting of ordinary white numerous filaments. Abdominal terga from second to sixth each with a median raquetlike impression (text fig. 8, *f*); typical chætotaxy of abdominal segments as follows: On tergal side one pair of simple setæ on anterior part, three pairs of simple setæ on posterior parts, and a pair of simple or branched setæ on the lateral part; on sternal side, one pair on anterior part and three pairs on posterior part; lateral sides from segment one to segment four each with three isolated setæ, those from fifth to seventh each with four

long swimming hairs on either lateral lamella, that of eighth with five swimming hairs on lamella; tergal side with characteristic spinulose areas: First tergum with a pair of lateral spinulose areas, second almost entirely spinulose except middorsal area, spinules of caudomesal area of this segment comparatively strong, third to sixth terga uniformly spinulose, seventh and eighth with spinulose areas more or less reduced, each provided with a pair of lateral spinulose areas; second tergum with a complete caudal transverse line of hooklets (text fig. 8, *e*); caudolateral corner of eighth segment with a variable number of solid

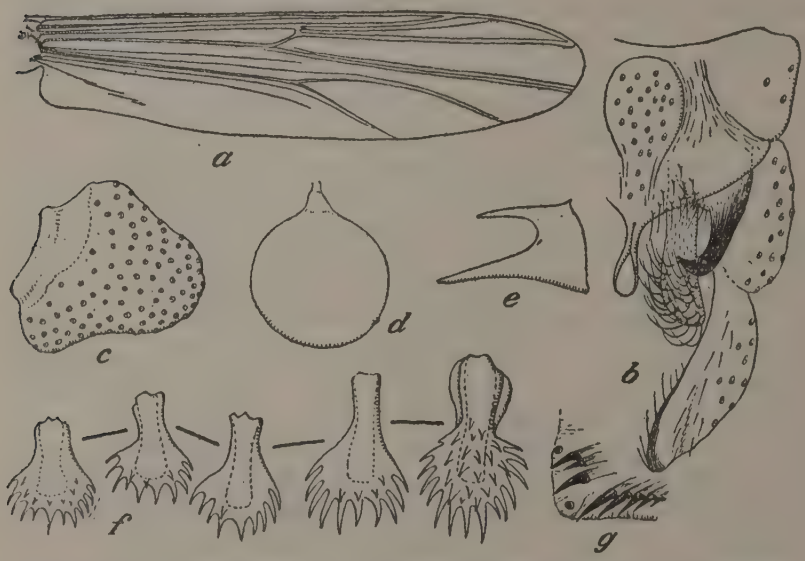


FIG. 8. *Chironomus* (*Glyptotendipes*) *glaucus* Meigen. *a*, Male wing; *b*, male hypopygium; *c*, female cercus; *d*, spermatheca; *e*, hooklet of second abdominal tergum of pupa; *f*, dorsal impressions of terga from second to sixth abdominal segments of pupa; *g*, caudolateral spines of eighth segment of pupa.

spines (text fig. 8, *g*). Ultimate segment almost circular, genital sheaths hardly beyond caudal margin of swimming lamellæ even in male.

Habitat.—Stagnant water; Tomioka, Kyushu, Japan.

Specimens.—Alcoholic egg masses, larvæ, pupæ, and male and female imagines; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

CHIRONOMUS (STENOCHIRONOMUS) TAKAHASHII sp. nov.

There have been known only three species of the subgenus *Stenochironomus* Kieffer from Japan; namely, *C. bitensis* Kief-

fer, *C. nelumbus* Tokunaga and Kuroda, and *C. satorui* Tokunaga and Kuroda. The present species, therefore, is the fourth of this subgenus. The male and the immature stages are still unknown.

Female.—Body about 3.5 millimeters long, yellowish white in ground color. Legs with characteristic markings. Wings very closely allied to those of *C. satorui* in markings but without apical markings. Setæ of body yellow. Head yellowish brown, with vertex brown, frontoclypeus brown. Maxillary palpus black, 5-segmented (4 : 5 : 17 : 14 : 22); antenna yellow, with ultimate segment yellowish brown, with two long apical setæ; intermediate flagellar segments each with a long neck region; second segment double; relative lengths of antennal segments, 5 : 12.5 : 9.5 : 8.5 : 8 : 11. Thorax yellow in ground color; scutum with paired dark-brown lateral vittæ, without median vittæ; scutellum yellowish brown; postscutellum black, with a yellow median line; pleural sclerites yellowish brown; epimeron

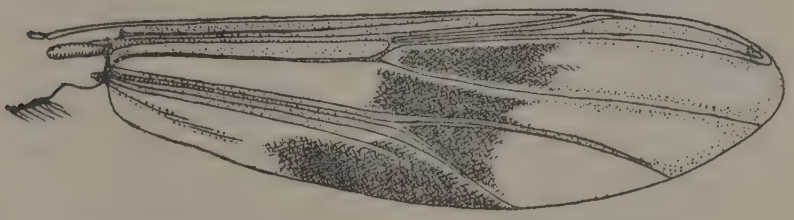


Fig. 9. *Chironomus* (*Stenochironomus*) *takahashii* sp. nov. Female wing.

dark brown; other parts yellow. Legs yellow in ground color; fore coxa yellow, middle and hind coxæ brown; fore femur mainly black, brown at both ends; middle and hind femora black on basal half, yellow on apical half, broadly brown at both ends; tibiæ of all legs black on basal half, yellow on apical half, brown or dark brown at base; other segments uniformly yellowish white. Tibial combs each with a spur; pulvilli large, as long as claws; empodium slender. Proportional lengths of segments of legs as follows: 97 : 81 : 92 : 52 : 41.5 : 31 : 15 in foreleg, 95 : 80 : 49 : 27 : 19.5 : 13 : 9 in middle leg, and 115 : 100 : 69 : 41 : 31 : 20 : 10 in hind leg. Wing (text fig. 9) with a median large dark band, which extends proximad along anal margin; veins yellow, marginal areas along M_{1+2}, M_{3+4}, and Cu_1 yellow; apical margin of wing also yellowish; wing cells along costal margin C, Sc, R, R_1, and R_3 entirely yellow. Venation as in *C. satorui*. Halteres white.

Abdomen yellowish white; posterior segments somewhat brownish.

Habitat.—Northern Formosa.

Holotype.—Alcoholic female; Koyo, Taito-cho, Taihoku, Formosa; June, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. R. Takahashi.

CHIRONOMUS (POLYPEDILUM) KYOTOENSIS sp. nov.

This midge was reared in the laboratory from the larva collected at the botanical garden of the Kyoto Imperial University.

Male.—Body about 3.6 millimeters long, dark brown in ground color. Thorax dark brown with three black lines along middorsal and pseudosutural lines. Wings without colored markings. Legs uniformly pale brown. Head without frontal tubercles; eyes narrowly separated above; antenna black, with scape brown on basal half, 14-segmented, with two apical setæ, plumose hairs black; antennal ratio about 1.9; maxillary palpus brown, with four distinct segments (3 : 6 : 7 : 10). Thorax pruinose; scutum dark brown, with black middorsal and pseudosutural lines; scutellum brown; postscutellum black; pleura and sternum shiny, black. Foreleg with a distinct apical spine of tibia; leg ratio of foreleg about 1.7; pulvilli slender, bifurcate; empodium slender. Wing (text fig. 10, *a*) very slightly clouded entirely, with veins pale brown; R_{2+3} extending closely along R_1; R_{4+5} ending very near wing tip, gradually curved caudad on apical part; fMCu just under fR; 1st A atrophied under fMCu. Halteres yellow. Abdomen black; terga from second to sixth with paired pale brown spots on caudal corners; ultimate tergum (text fig. 10, *b*) broadly pale brown on cephalic margin, with several long setæ on meson; anal point slender, long, beyond distal end of coxite; style straight, as long as coxite, not sharply narrowed distad; dorsal appendage with basal portion swollen, pubescent, with a long isolated seta, distal portion slender, long, nonpubescent; ventral appendage very slender, long, extending beyond distal end of coxite, with several (4 or 5) curved apical bristles and a very long apical seta.

Female.—Body about 2.5 millimeters long; coloration as in male. Antenna brown, 6-segmented (4 : 7 : 5 : 5.5 : 3 : 9), with three apical setæ; maxillary palpus with four distinct segments (3 : 6 : 7 : 11). Foreleg ratio about 1.8. Wing (text fig. 10, *c*) broader and shorter than in male; anal angle obtuse. Abdomen uniformly dark brown; ultimate sternum with a shallow caudal incision, setigerous only on laterocaudal areas; spermathecæ (text fig. 10, *d*) two, oval, yellow, with short neck re-

gion; cercus (text fig. 10, *e*) with a short ventrocephalic projection.

Pupa.—Body about 3.5 millimeters long; head with a small tubercle on each scape; thoracic respiratory organ (text fig. 10, *f*) branched into seven subequal filaments; abdomen with characteristic cuticular processes. First abdominal segment with a pair of large anterior and small posterior lateral swellings, without dorsal spinous area; second tergum with a transverse

FIG. 10. *Chironomus* (*Polypedilum*) *kyotoensis* sp. nov. *a*, Male wing; *b*, male hypopygium; *c*, female wing; *d*, spermatheca; *e*, female cercus; *f*, thoracic respiratory organ of pupa; *g*, caudolateral spine of abdominal segment eight of pupa; *h*, larval mandible; *i*, larval maxilla; *j*, larval antenna; *k*, larval mentum; *l*, larval labrum-epipharynx.

spinulous area on anterior region and a line of recurved thorn-like spines on posterior margin; third tergum with a transverse spinulous area on anterior region; fourth terga with an X-shaped spinulous area on anterior half, a pair of oval spinulous areas on caudal region, and a pair of small spinous patches on caudolateral sides; fifth tergum with a large median X-shaped spinulous area, lateral swimming lamellæ and three pairs of long lateral setæ; sixth tergum similar to fifth, but with X-shaped spinulous area narrow; seventh with a pair of small spinulous

areas on anterior region and four pairs of long lateral setæ on lateral swimming lamellæ; eighth similar to seventh, but without spinulous areas, with a pair of imbricate caudolateral large spines (text fig. 10, *g*); ninth segment with a pair of large lateral swimming lamellæ, each of which is provided with about thirty-seven long marginal setæ, with a U-shaped caudal incision; genital sheaths long, pointed, far beyond caudal margin of ultimate segment in both sexes.

Larva.—Body about 6 millimeters long. Head with three unpaired sclerites of clypeus, of which the preclypeal plate is thinly membranous on mesal oval area; labrum-epipharynx (text fig. 10, *l*) with three paired sclerites; namely, clypealiæ, tormæ, and labraliæ, on lateral sides; labral membrane with following cuticular appendages: One pair of plumose projections which arise from basal rings, paired lateral groups of three simple and two serrulate trichoid projections, and a group of distomesal appendages which are composed of two plumose projections arising from a common basal plate, and two pairs of small comblike projections; epipharynx with following cuticular appendages: A median appendage composed of two strongly serrate thornlike projections which are partially fused with each other on their basal parts, paired groups of thornlike projections which are composed of two large serrulate, and five larger and two smaller simple projections, along each arm of V-shaped thickening; two small plates located at caudal angle of V-shaped thickening; premandible with two strong and a small basal tooth; mandible (text fig. 10, *h*) with four cutting teeth, an apical spinelike projection, a small trichoid projection on molar edge, four slender setæ on apical part, a line of slender setæ along molar edge, several plumose hyaline projections at mesal base, and two isolated setæ on lateral surface; maxilla (text fig. 10, *i*) with two apical lobes; mesal lobe with two strong projections, two slender setæ, a trichoid sensilla, and three peglike sensillæ; lateral lobe with two small setæ and a palpus; palpus 3-segmented, consisting of a large basal segment, two small distal segments, and several small sensory projections on the distal end of first segment; labium without apical membranous projections; mentum (text fig. 10, *k*) with seven pairs of teeth, median tooth large, second small, third as large as median, fourth and fifth teeth small as in second, sixth somewhat larger than adjacent, seventh smallest; submentum fanlike, finely striated; paired setæ of mentum simple; hypopharynx with a pair of scalelike or comb-

like mesal projections, four pairs of peglike sensillæ, and spinous area on dorsal side, without common salivary duct. Antenna (text fig. 10, *j*) 5-segmented, first segment with a very long trichoid projection which extends beyond antennal tip. Anterior pseudopod with numerous simple claws; posterior pseudopod with sixteen simple claws; caudal tuft of setæ consisting of eight long setæ arised from a small basal projection; anal gills conical, dorsal pair of them large, slightly constricted preapically; ventral pair small, not constricted.

Habitat.—Fresh water; Honshu, Japan.

Holotype.—Male; Kitashirakawa, Kyoto; October 3, 1935.

Allotopotype.—Female; October 3, 1935.

Paratopotypes.—Males and females; October 3, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is closely allied to *P. integrum* Kieffer and *P. albicornis* Meigen. In the first allied species, however, the dorsal appendage of the male hypopygium is curved and the foreleg ratio is 1.3, and in the second species the male antennæ are provided with yellow plumose hairs and the foreleg ratio is 1.4, both differing from the present species.

CHIRONOMUS (POLYPEDILUM) MASUDAI sp. nov.

Collected at light screen at Yamashina, Kyoto.

Male.—Body about 2.5 millimeters long, brown in ground color. Antenna with several apical setæ; antennal ratio about

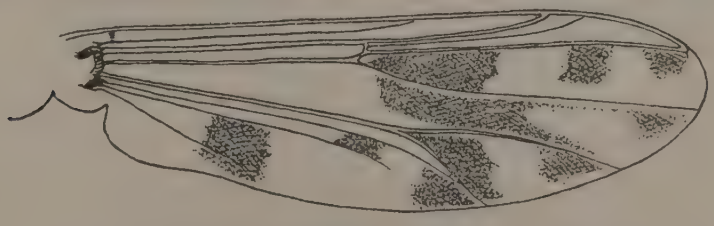


FIG. 11. *Chironomus* (*Polypedilum*) *masudai* sp. nov. Male wing.

1.5. Thorax brown in ground color; vittæ three, separated, dark brown; caudoscutal area dark brown; scutellum pale brown; postscutellum and sternal side black; pronotum dark brown. Legs with coxæ and trochanters dark brown; femora mainly dark brown, pale brown on apical third; tibiæ entirely pale brown; tarsal segments extensively pale brown; first segment

with a distinct black preapical ring; other segments each with a distinct black ring at middle; ultimate tarsal segments indistinctly dark brown uniformly. Relative lengths of segments of foreleg, 41 : 28 : 52 : 35 : 27 : 20 : 10. Wing (text fig. 11) with nine dark markings, veins yellow. Halteres black, with stems pale brown. Hypopygium (text fig. 12) with anal point slender, simple; style very slender, pointed; dorsal appendage broad, flat, with three long and several small setæ; ventral appendage with a terminal hair only moderately long.

FIG. 12. *Chironomus (Polypedilum) masudai* sp. nov. Male hypopygium.

Habitat.—Honshu, Japan.

Holotype.—Male; Yamashina, Kyoto; October 11, 1935.

Paratopotypes.—Males; October 11, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. T. Masuda.

This species is named in honor of the collector, Mr. Tadao Masuda. The present fly is somewhat related to *C. heptasticum* Kieffer and *C. lætus* Meigen, but in the former allied species the dorsal appendages of the male hypopygium are bare and the legs are white, and the latter differs greatly from *C. masudai* in having the wing cell R_1 provided with a dark streak along the vein M, and in being without two distal spots.

CHIRONOMUS (POLYPEDILUM) JAPONICUS sp. nov.

Very common in Kyoto in spring and autumn and often found at light screen.

Male.—Body about 2.7 millimeters long; thorax dark brown in ground color; wing with four distinct dark markings. Femora black on proximal two-thirds, yellow on distal third; knee

joints narrowly black. Antennæ and plumose hairs brown, with scapes black, each with two apical setæ; antennal ratio about 1.4 to 1.5. Maxillary palpi brown, distinctly 4-segmented (2 : 5 : 6 : 10). Scutum with three indistinct black vittæ, pseudosutural foveæ brown, caudoscutal area dark brown; scutellum brown; postscutellum black, with a brown median stripe; pleural and sternal sclerites black. Legs with coxæ and trochanters

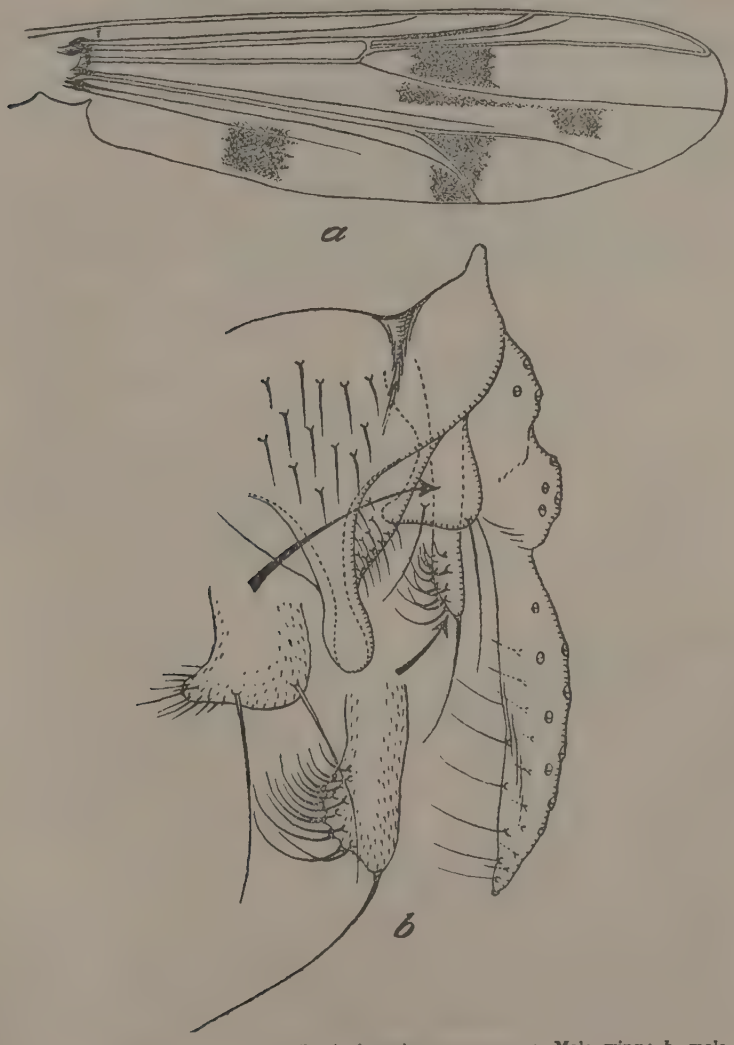


FIG. 13. *Chironomus* (*Polypedilum*) *japonicus* sp. nov. *a*, Male wing; *b*, male hypopygium.

black; femora distinctly bicolored; tibiæ and tarsus yellowish brown; pulvilli comparatively large. Relative lengths of segments of foreleg, 44.7 : 26.7 : 55.3 : 34 : 25.7 : 19 : 9.5. Halteres yellow. Wing (text fig. 13, *a*) with three large markings and a small dark marking, all square; a distinct linear marking along caudal margin of vein M_{1+2}; veins mainly yellow; R_1 and R_{4+5} black in the area of dark marking. Abdomen mainly yellow; posterior segments brown or black; hypopygium (text fig. 13, *b*) black; ultimate tergum setigerous on mesal area, finely setigerous apical area, with anal point broad and thickened; dorsal appendage distinctly swollen, with two long isolated setæ on dorsal side, many small setæ on mesal corner; ventral appendage with a comparatively short apical seta.

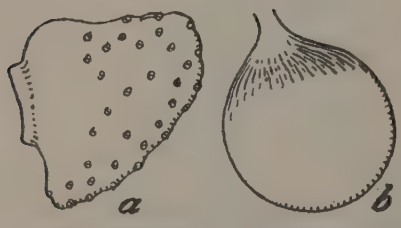


FIG. 14. *Chironomus* (*Polypedilum*) *japonicus* sp. nov. *a*, Female cercus; *b*, spermatheca.

Female.—Body length about 2 millimeters, coloration largely as in male. Antennæ 6-segmented (4 : 8 : 6 : 6.2 : 3.7 : 9), with several apical setæ; segment two distinctly constricted before middle; segments two to four each with an elongated neck region; penultimate short, fusiform; ultimate slender, without ordinary setæ, not swollen basally. Relative lengths of segments of foreleg, 54 : 31 : 66 : 40 : 30 : 23 : 11. Abdomen with anterior two or three segments yellow, other posterior segments brown; spermathecæ (text fig. 14, *b*) two, spherical, mainly pale brown, brown on basal part, with hyaline neck region; cerci (text fig. 14, *a*) subtriangular, with ventral corner prominent.

Habitat.—Honshu, Japan.

Holotype.—Male; Shimogamo, Kyoto; May 18, 1930.

Allotopotype.—Female; May 18, 1930.

Paratopotypes.—Males and females, Shimogamo and Kitashirakawa, Kyoto, May 18, 1930, and October 30, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is closely related to the European *C.* (*P.*) *scalænus* Schrank var. *quadriguttatus* Kieffer, from which it differs, however, in the wing cell M_2 not being provided with a dark linear stripe along M_{1+2}.

CHIRONOMUS (POLYPEDILUM) UNIFASCIA sp. nov.

This fly was collected at light at Yamashina, Kyoto.

Female.—Body length about 1.7 millimeters; thorax mainly dark brown; abdomen largely pale brown. Wing (text fig. 15, *a*) with a transverse dark band at distal third, and a square marking at middle of anal cell. Antennæ pale brown, with several apical setæ, 6-segmented (3 : 5 : 3.5 : 4 : 3 : 6.7). Thorax almost entirely dark brown; scutal vittæ indistinct; scutellum pale brown; pleural and sternal sclerites black. Legs with coxæ dark brown, trochanters brown; femora dark brown on proximal half and pale brown on distal half; tibiæ and tarsi uniformly pale brown; relative lengths of fore femur and tibiæ about 28 : 20. Halteres yellow. Wings as in the figure; dark marking of cell M_2 large, extending distad along veins M_{1+2} and M_{3+4}, branching

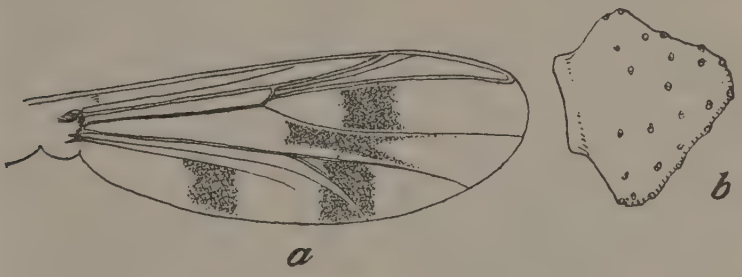


FIG. 15. *Chironomus* (*Polypedilum*) *unifascia* sp. nov. *a*, Female wing; *b*, female cercus.

into two distal stripes. Abdomen pale brown, eighth segment black; cerci (text fig. 15, *b*) somewhat pentagonal, with ventral angle prominent.

Habitat.—Honshu, Japan.

Holotype.—Female; Yamashina, Kyoto, Otcober 11, 1935.

Paratopotypes.—Females; October 11, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. Tadao Masuda.

This species is very closely allied to *C.* (*P.*) *scalænus* Schrank, from which it is easily distinguished by the dark marking in wing cell M_2.

CHIRONOMUS (POLYPEDILUM) SAGITTIFERUS sp. nov.

Collected at light at Yamashina, Kyoto.

Male.—Body 2 to 3 millimeters long; coloration closely similar to that of *C.* (*P.*) *masudai*. Antenna with about five apical

FIG. 16. *Chironomus* (*Polypedilum*) *sagittiferus* sp. nov. Male wing.

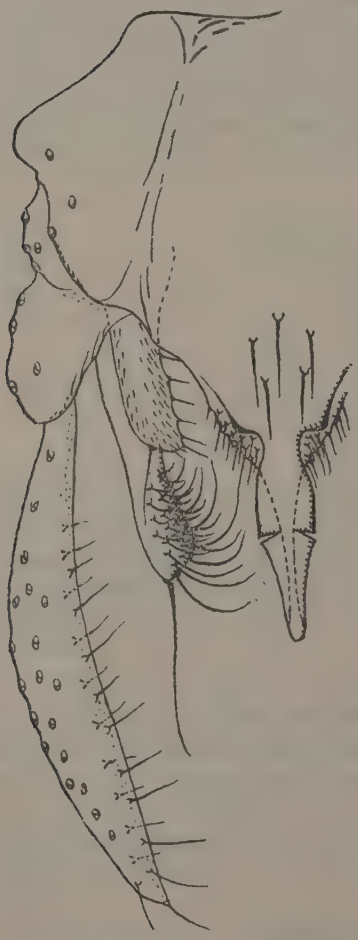


FIG. 17. *Chironomus* (*Polypedilum*) *sagittiferus* sp. nov. Male hypopygium.

setæ; antennal ratio about 1.8. Legs with coxæ black, trochanters dark brown; fore femur dark brown or black on proximal two-thirds, pale brown on distal third; fore tibia pale brown or yellow; fore tarsus yellowish on proximal two segments, brown on distal three segments; middle and hind femora black on proximal half or more, pale brown on distal half; tibiæ uniformly pale brown or yellow; tarsus dark brown, each segment with an obscure apical pale-brown ring. Relative lengths of segments of foreleg 57 : 37 : 73 : 45 : 34 : 26 : 13. Wing (text fig. 16) with eight distinct dark markings; veins yellow. Haltere with pale-brown stem and dark knob. Hypopygium (text fig. 17) with style very slender; anal point trilobate, with a pair of basal thickenings and a pair of preapical incisions; ventral appendage with an apical seta very long, extending directly caudad.

Habitat.—Honshu, Japan.

Holotype.—Male; Yamashina, Kyoto; October 11, 1935.

Paratopotypes.—Males; October 11, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. T. Masuda.

This species is somewhat related to *C.* (*P.*) *apfelbecki* Strobl, in which, however, the dark cloud between M_{1+2} and M_{3+4} is small and very obscure, the basal half of the wing shows a transverse dark band before r-m, and the male hypopygium carries a needle-like anal point.

CHIRONOMUS (POLYPEDILUM) DECEMATOGUTTATUS sp. nov.

Found at light.

Male.—Body about 4.6 millimeters long; thorax dark brown in ground color, with four distinct black vittæ on scutum; halteres with knobs black, stems pale brown; wings with many dark markings. Antennæ brown, with scape black, with about five apical setæ; antennal ratio about 2; maxillary palpus pale brown. Thoracic pleural and sternal sclerites and postscutellum black; scutellum pale brown; scutum with four distinct black vittæ, caudoscutal area brown. Legs with coxæ and trochanters dark brown, all femora dark brown on proximal two-thirds and pale brown on distal third; tibiæ of all legs largely pale brown, with proximal ends brown; fore tarsus mainly yellow, with second segment dark brown on proximal fourth, third also dark brown on proximal third, fourth and fifth segments dark brown on proximal half; middle tarsus also mainly yellow, with second to fourth segment dark brown on proximal half; hind tarsus with each segment dark brown on basal third or half. Proportional lengths of segments of foreleg as follows: 73 : 51 : 90 : 60 : 47 : 35 : 17. Wing (text fig. 18, *a*) with ten distinct dark markings: Three in cell R_5, three in cell M_2, one covering distal section of Cu_1, one at distal corner of cell M_1, and two in anal cell. Abdomen entirely brown. Hypopygium (text fig. 18, *b*) with peculiar anal point; dorsal appendage swollen apically, with a long isolated seta; ventral appendage with a very long apical seta.

Female.—Body about 4 millimeters long, coloration as in male. Antenna 6-segmented (4 : 9 : 7 : 7.5 : 4.4 : 12), with three apical setæ; intermediate flagellar segments two to four each with a distinct neck region. Legs with tibiæ entirely pale brown, differing from male; proportional lengths of segments of foreleg 69 : 50 : 88 : 56 : 45 : 35 : 17. Abdomen with cerci (text fig.

18, *c*) pale brown, earlike; spermathecæ short-oval, colorless, hyaline, each with a neck region brown.

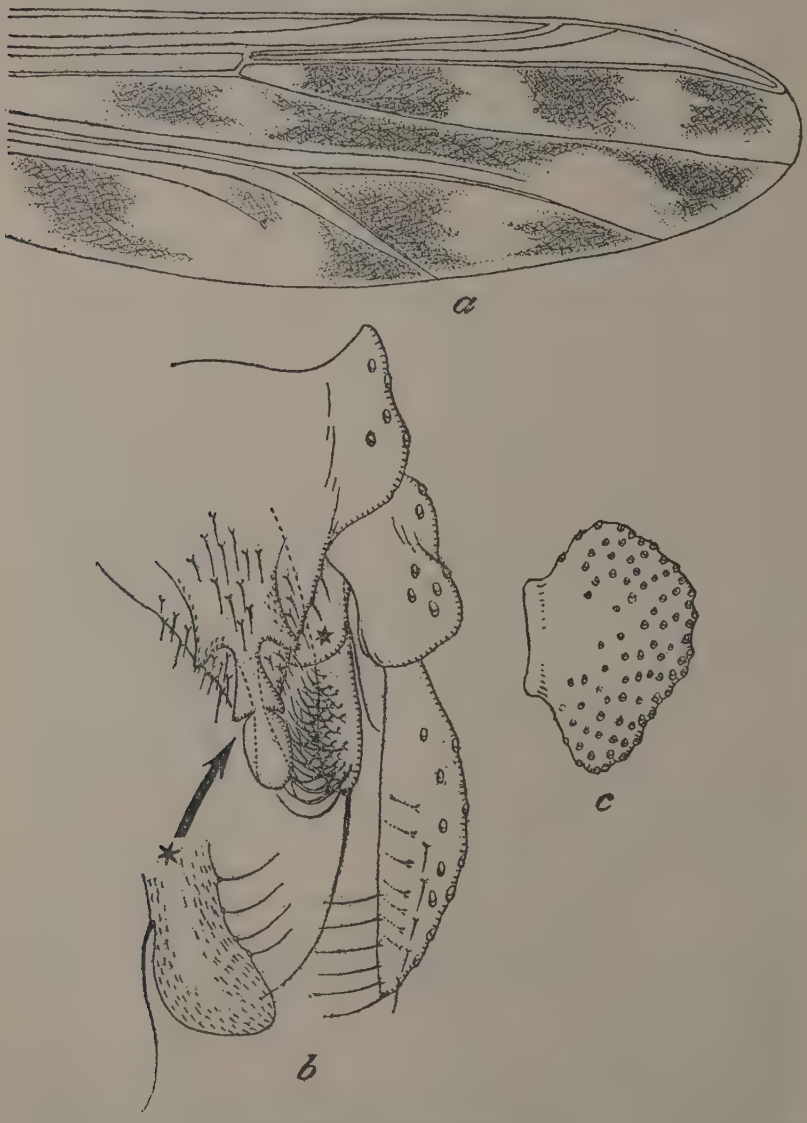


FIG. 18. *Chironomus* (*Polypedilum*) *decematoguttatus* sp. nov. *a*, Male wing; *b*, male hypopygium; *c*, female cercus.

Habitat.—Honshu, Japan.
Holotype.—Male; Shimogamo, Kyoto; May 18, 1930.

Allotopotype.—Female; May 18, 1930.

Paratopotypes.—Males; May 18, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is quite different from the other species of this subgenus in the characteristic structures of the male hypopygium. The wing markings are somewhat similar to those of an American *C.* (*P.*) *octopunctatus* Loew and a Japanese *C.* (*P.*) *octoguttatus* Tokunaga, but the wings of these are provided with only two markings in cell M_2 and lack the apical markings in cell M_4.

CHIRONOMUS (POLYPEDILUM) MULTANNULATUS sp. nov.

Collected at light from Kyushu and Honshu, but not abundant. The male is still unknown.

Female.—Body length about 4 millimeters; thoracic ground color dark brown, distinctly pruinose, with three black scutal vittæ. Legs with numerous colored rings. Halteres yellow, Wing with distal area, distad of r-m, mainly black, with a number of hyaline spots. Head entirely brown, including mouth parts and antennæ; antennæ with two apical setæ, 6-segmented (4 : 8.5 : 5.5 : 7 : 6 : 11) ; intermediate flagellar segments each with a distinct neck region. Thoracic scutum with a median black vitta which is narrowly extended caudad, reaching to scutellum, and indistinctly separated by a paler middorsal stripe; on this stripe a very narrow black middorsal line; caudoscutal area between two caudal extensions of a median vitta triangular; pale brown; two stripes along foveæ pale brown; postscutellum and pleural and sternal sclerites black. Legs mainly brown with many pale rings; coxæ and trochanters entirely brown; femora mainly brown, each with two broad pale rings, and often fore femur yellow on basal third, basal yellow ring very broad extending to the proximal end; tibiæ of fore and hind legs each with two broad pale rings, often without basal pale brown ring; middle tibia with three broad pale rings, including a very broad apical ring, and often uniformly dark brown on basal three-fourths, two basal yellow rings absent; tarsi of legs mainly yellow, with two proximal segments narrowly brown or black on distal end, segments three and four also pale brown or brown on distal half or more, ultimate segment entirely pale brown. Relative lengths of segments of foreleg 82 : 68 : 97 : 66 : 50 : 43 : 18. Wing (text fig. 19, *a*) dark on apical half or more,

with distinct but subconfluent clear spots on marginal and apical part; cell R_5 with an isolated distinct circular clear spot before middle; anal cell with a dark cloud before middle. Abdomen comparatively slender, brown, distal end curved upwards in life; cerci (text fig. 19, *b*) earlike, yellow, with ventral projection prominent; spermathecæ (text fig. 19, *c*) oval, clear, with duct on side.

Habitat.—Honshu and Kyushu, Japan.

Holotype.—Female; Shimogamo, Kyoto; May 18, 1930.

Paratypes.—Females; Hita, Oita Prefecture; April 12, 1936; and Hachijo, Kyoto; June 8, 1937.

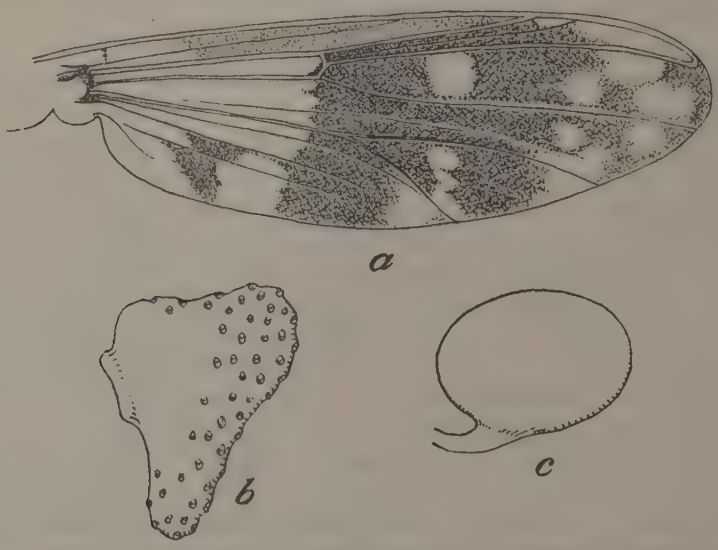


FIG. 19. *Chironomus* (*Polypedilum*) *multannulatus* sp. nov. *a*, Female wing; *b*, female cercus; *c*, female spermatheca.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. Y. Yamada and M. Tokunaga.

This species is somewhat allied to the American *C.* (*P.*) *perpulcher* Mitchell, in which, however, the dark wing area extends more proximad far beyond r-m, thus being completely fused with the anal cloud; moreover, the latter differs from the Japanese species in having an incomplete transverse clear band at the position of the circular clear spot of cell R_5.

TANYTARSUS (TANYTARSUS) STAGNARIUS sp. nov.

This species is very common along stagnant water in Kyoto.

Male.—Body 2.8 to 2.9 millimeters long, not highly setigerous, brown, without distinct dorsal vittæ; scapes of antennæ pale brown, flagella brown; legs, halteres, and abdomen yellowish pale brown. Wings hyaline under transmitted light. Frontal tubercles present, minute, papilliform; eyes bare, reniform, narrow; distance between them narrow and about half as wide as vertical length of eye; antennæ 14-segmented; ultimate segment with two short apical setæ; antennal ratio about 1.3 (4 : 3); maxillary palpi slender, 4-segmented (15 : 52 : 59 : 90). Scutellum with a pair of long median setæ closely situated to each other, two pairs of short lateral setæ arranged in a transverse line on cephalic part; only one on supra-alar seta. Abdomen slender; coxite with four slender setæ on chitinized ventral margin; style slender, extending dorsocaudad, with many slender setæ on mesal side; dorsal appendage somewhat hemispherical, thinly membranous, with several small setæ on dorsomesal part; its accessory lobe relatively large, clawlike, extending mesad beyond dorsal lobe; intermediate appendage short, not extending to middle of style, with many strong curved setæ on dorsomesal side of distal part, a few long setæ on ventrolateral part; ventroproximal appendage slender, long, reaching end of intermediate appendage, with many clavate hairs on dorsal side of distal part; ultimate tergum with a large V-shaped thickening, a pair of small tubercles on lateral side, several small setæ very closely situated to each other on caudomesal part, several minute setæ on caudal margin near anal point; anal point small, extending dorsad, then curved caudad (text fig. 20, *e*). Foreleg with a small fixed tibial spur not longer than half of diameter of tibial end; foreleg ratio about 2; tibial combs distinctly separated from each other, occupying at most half of circumference of tibial end, each with a spur; empodium slender, as long as claws; pulvilli wanting. Wings (text fig. 20, *a*) about 1.8 millimeters long, thickly haired; anal angle atrophied; fringe of anal margin long; vein R_{4+5} ending a little beyond level of tip of M_{3+4}, shorter than twice R_1 (13 : 8); fMCu a little beyond r-m, narrow; M_{3+4} very lightly bent caudad at tip; 1st A slightly beyond base of fMCu.

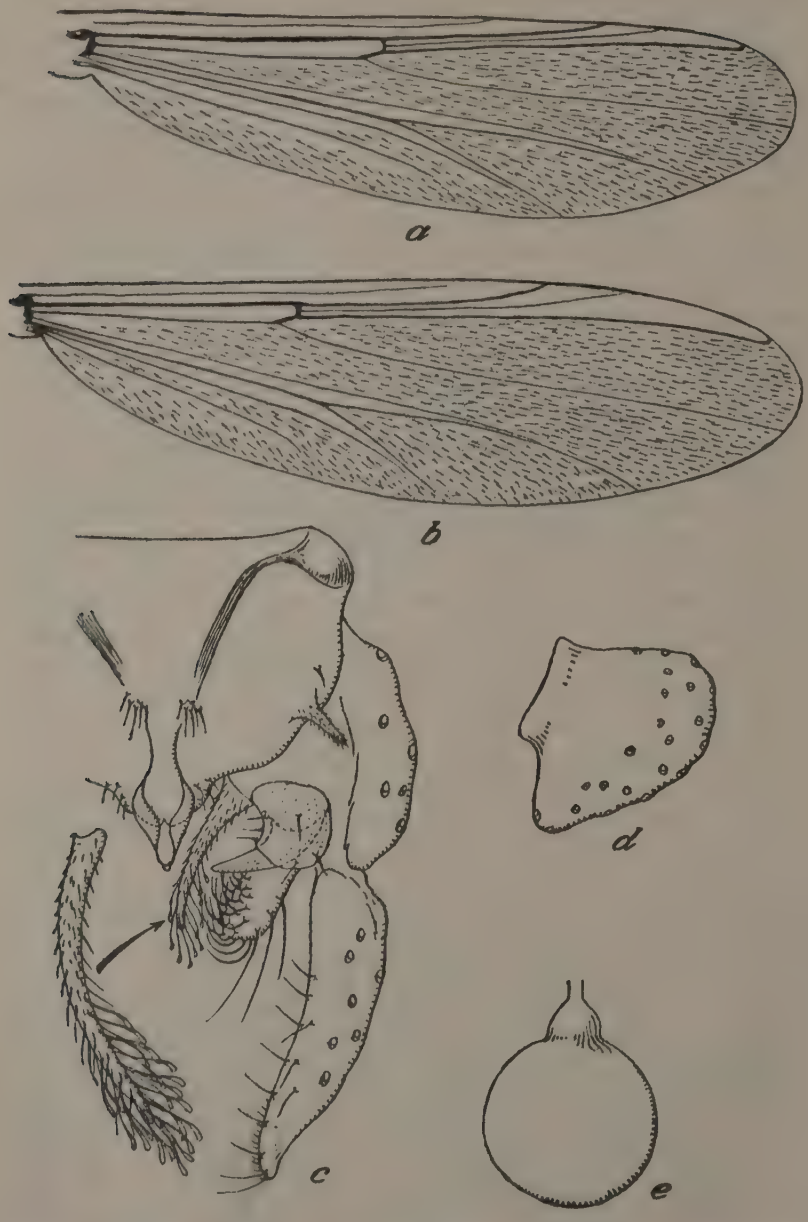


FIG. 20. *Tanytarsus* (*Tanytarsus*) *stagnarius* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus; *e*, spermatheca.

Female.—Body 2.1 to 2.2 millimeters long; coloration as in male, but antennæ uniformly pale brown; frontal tubercles more distinct than in male, cylindrical; eyes reniform, broader than in male; distance between them far wider than in male, a little narrower than vertical length of eye (10 : 13); antennæ 5-segmented; ultimate segment subequal to two preceding segments taken together (59 : 26+24), without apical setæ; second segment constricted shallowly; maxillary palpi slender; distal joint longer than two preceding segments taken together (14 : 35 : 47 : 87). Ultimate sternum setigerous, with a very shallow caudal incision and a deep V-shaped ental thickening. Cerci (text fig. 20, *d*) setigerous, with small setæ on lateral side, with ventral area slightly extending ventrocephalad and angulated; spermathecæ (text fig. 20, *e*) spherical, hyaline, with neck region. Foreleg ratio larger than in male, rather variable, about 2.6 to 3; tibial combs smaller and more separated than in male occupying about two-thirds of circumference of tibial end. Wings (text fig. 20, *b*) about 1.9 to 2 millimeters, relatively broader than in male; R_{4+5} ending far distad beyond level of tip of M_{3+4}, shorter than twice R_1 (66 : 37); M_{3+4} distinctly curved caudad at distal part. Other structures of head, thorax. wings, and legs essentially similar to those of male.

Habitat.—Stagnant water; Honshu, Japan.

Holotype.—Male; Kitashirakawa, Kyoto; May 25, 1930.

Allotopotype.—Female; May 25, 1930.

Paratopotypes.—Males and females; May 25, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is allied to *T. tenuis* Meigen, in which, however, the foreleg ratio is 1.5, the tibial combs are scarcely separated, the thorax is provided with reddish black vittæ, and the female antennæ is 6-segmented.

TANYTARSUS (TANYTARSUS) PARVICRINIS sp. nov.

This midge was found along a stream in a hilly district of Kyoto.

Male.—Body about 2.6 millimeters long, greenish white in ground color; head, antennæ, scutal vittæ, postscutellum, and sternal sides of thorax greenish brown. Frontal tubercles obsolete; eyes bare, distance between them half their vertical

length; maxillary palpi distinctly 4-segmented (2 : 6 : 7 : 13); antennal ratio 0.4 to 0.5; antennæ 14-segmented, ultimate segment with a small apical seta. Supra-alar seta only one; scutellum with one median and two lateral pairs of setæ. Hypopygium (text fig. 21, *c*) with anal point very long, V-shaped thickening of ultimate tergum almost atrophied, represented only by short arms; dorsal appendage somewhat triangular in dorsal aspect, with a few minute setæ on dorsal surface and one or two setæ on mesal margin; accessory lobe absent; intermediate appendage constricted preapically, up-curved, with many strong curved setæ on dorsal side of swollen tip; ventroproximal appendage very small, with stem very short and slightly pubescent; its terminal tuft consisting of many flat hairs

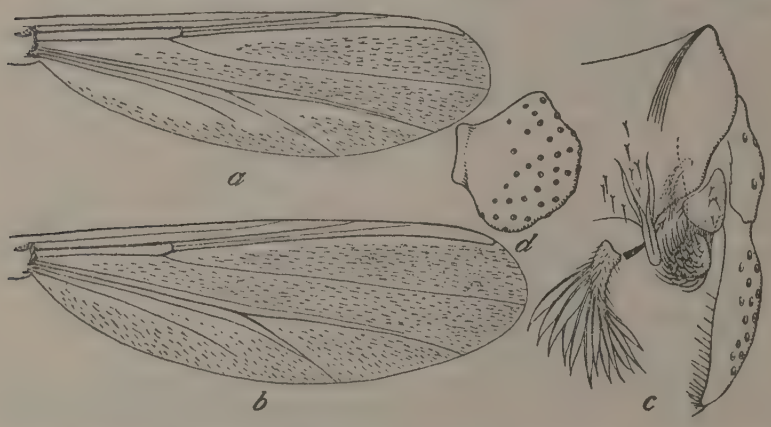


FIG. 21. *Tanytarsus* (*Tanytarsus*) *parvicrinis* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus.

which are about twice as long as stem. Legs without beards; foreleg ratio about 2 (50 : 27); fixed tibial spine of foreleg about half as long as diameter of tibia; four posterior legs each with two large combs which are widely separated from each other and occupy about one-third of circumference of end of tibia; combs each provided with a spur which is fully twice as long as comb; no pulvilli. Wings (text fig. 21, *a*) about 2 millimeters long, comparatively broad, with macrotrichia spread over almost entire surface; anal angle almost atrophied; vein R_{4+5} hardly twice as long as R_1 (21 : 12), ending slightly beyond level of tip of M_{3+4}; M_{1+2} long, about $2\frac{1}{2}$ the length of medial stem (70 : 29); fMCu far beyond base of Rs; r-m short, slightly longer than basal section of Rs, slightly oblique in position.

Female.—Body length about 2.1 millimeters; ground color far paler than in male; head, scutal vittæ, and postscutellum yellowish brown. Antennæ 6-segmented (21 : 35 : 22 : 24 : 25 : 35); ultimate segment with two apical setæ, one long and the other short. Ultimate abdominal sternum broad; spermathecæ two, hyaline, oval; cerci (text fig. 21, *d*) small, very short, angulated. Wings (text fig. 21, *b*) slightly larger and broader than in male, about 2.1 millimeters long; relative lengths of veins R_{4+5} and R_1 73 : 43; M_{1+2} long, fully thrice as long as median stem. Other structures of head, thorax, wings, and legs closely similar to those of male.

Habitat.—Running water; Honshu, Japan.

Holotype.—Male; Kibune, Kyoto; April 10, 1932.

Allotopotype.—Female; April 10, 1932.

Paratopotypes.—Males and females; April 10, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species differs highly from the other Japanese species of subgenus *Tanytarsus* in the possession of the very short terminal segment of the antenna in the male, which is only half as long as the twelve preceding segments taken together.

TANYTARSUS (TANYTARSUS) KYOTOENSIS sp. nov.

Very abundant along slow stream in Kyoto.

Male.—Body 1.9 to 2.8 millimeters long, highly setigerous, with long setæ; thorax reddish brown; dorsal vittæ and sternal side dark brown; postscutellum also dark brown but sometimes pale brown; abdomen yellowish semihyaline. Some individuals darker than in above description. Eyes bare, narrowly projected dorsad, not widely separated from each other on dorsal side; distance between them about half as wide as vertical length of eyes; antennæ 14-segmented; ultimate segment usually with an apical seta, subequal in length to ten preceding segments taken together; antennal ratio 0.8 to 0.9; maxillary palpi long, slender; ultimate maxillary segment subequal in length to two preceding segments taken together; clypeus highly setigerous, with long setæ. Pronotum greatly reduced; scutum with median vittæ short, ending at middle of scutum; supra-alar seta only one; scutellum with two very long median and four long and two short lateral setæ. Abdomen very slender. Hypopygium (text fig. 22, *a*) also setigerous; ultimate tergum with a long thickened anal point, setigerous with small setæ on median

part; ultimate sternum without macrotrichia; coxite setigerous, with very long, strong setæ, with five slender hairs on ventromesal margin; style prominently extending caudodorsad, with many slender hairs on mesal side; dorsal appendage thinly membranous, with several short setæ, expanded dorsad; its accessory lobe very small; intermediate appendage large, broad, curved at tip, crowned with many curved strong setæ, not extending caudad beyond anal point; ventroproximal appendage hardly as large as intermediate appendage, uniformly chitinized,

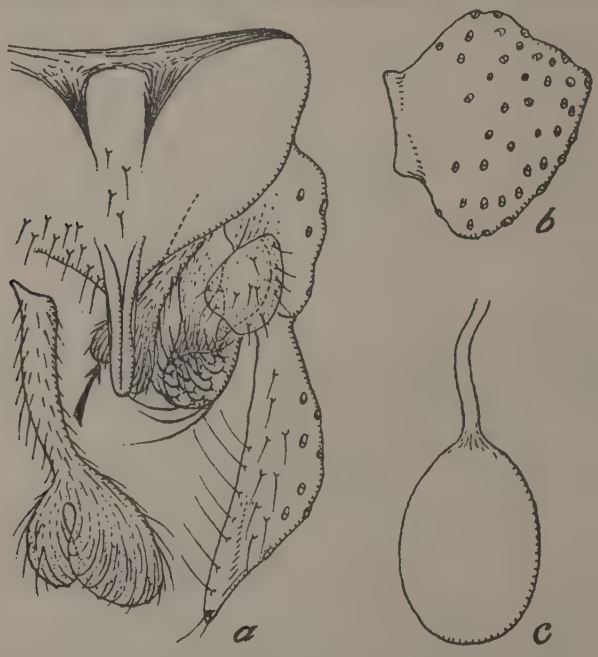


FIG. 22. *Tanytarsus* (*Tanytarsus*) *kyotoensis* sp. nov. *a*, Male hypopygium; *b*, female cercus; *c*, spermatheca.

setigerous on stem, bilobate distally; lateral arm forming a large membranous distal knob; mesal arm forming a small knob; these knobs hyaline, finely striated. Legs hairy, beards wanting; foreleg ratio 2 to 2.2; fore tibia with a fixed distal spine; two tibial combs distinct from each other, occupying about two-fifths of circumference of tibial end, each with a similar spur about twice as long as comb; claws each with two basal hairlike projections; pulvilli very small; empodium large, but shorter than claws. Wings (text fig. 23, *a*) 1.7 to 2.2 millimeters long, very slightly brown under transmitted light, densely

hairy on entire surface; anal angle completely atrophied; fringe of posterior margin long; vein R_{4+5} twice as long as radial stem, 1.7 times as long as R_1, ending just beyond level of tip of M_{3+4}; fMCu far beyond r-m; 1st A almost reaching base of fMCu.

Female.—Body about 1.7 to 2.3 millimeters long; coloration paler than in male. Eyes not projected dorsad, reniform; antennæ 6-segmented; ultimate segment subequal in length to preceding segment, other flagellar segments fusiform, each with six very long setæ and two sensory setæ. Hypopygium setigerous; ultimate tergum not pointed caudad; ultimate sternum very broad, setigerous on caudal half, with caudal incision very

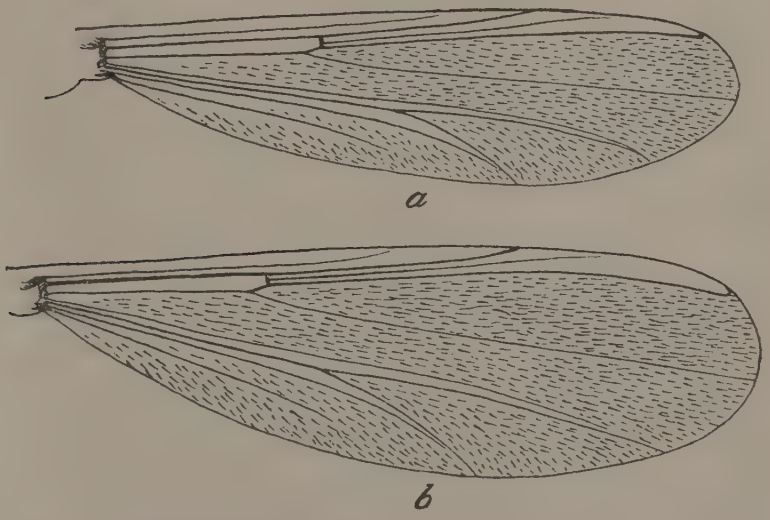


FIG. 23. *Tanytarsus* (*Tanytarsus*) *kyotoensis* sp. nov. *a*, Male wing; *b*, female wing.

small; cerci (text fig. 22, *b*) very small, somewhat rhombic; spermathecæ (text fig. 22, *c*) two, hyaline, oval. Wings (text fig. 23, *b*) 1.8 to 2.1 millimeters long, macrotrichia thicker than in male; anal angle atrophied. Other structures of head, thorax, wings, and legs as in male.

Habitat.—Running water; Honshu, Japan.

Holotype.—Male; Shimogamo, Kyoto; April 3, 1930.

Allotopotype.—Female; April 3, 1930.

Paratopotypes.—Males and females; Shimogamo and Kamigamo, Kyoto; April 3 to 14 and May 11 to 19, 1930, and April 10, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

The present species is somewhat related to *T. excavatus* Edwards and *T. glabrescens* Edwards, but highly specific in the structures of the ventroproximal appendages of the male hypopygium.

TANYTARSUS (TANYTARSUS) ATAGOENSIS sp. nov.

This fly was found along a rapid stream in a hilly district.

Male.—Body 1.9 to 2 millimeters long, slender, pale brown in ground color; dorsal vittæ and sternal side of thorax reddish brown; middorsal vittæ distinct, slightly paler than lateral vittæ; pleuron with a brown spot near wing basis; postscutellum reddish brown on caudal part; scapes of antennæ reddish brown. Eyes bare, reniform, widely separated from each other, distance between them on dorsal side wider than vertical length of eye (5 : 4); frontal tubercles present, very small; antennæ 14-segmented; ultimate segment usually with an apical seta, equal in length to five preceding segments taken together; antennal ratio about 0.5 (19 : 39); maxillary palpi slender, distinctly 4-segmented; last segment far shorter than two preceding segments taken together (10 : 7+7); clypeus with only about 12 to 15 setæ. Pronotum greatly reduced; scutum scantily haired; middorsal vittæ short, somewhat paler than lateral vittæ; supra-alar seta only one; scutellum with only four setæ. Abdomen scantily haired, very slender in general appearance; ultimate tergum (text fig. 24, *b*) also very scantily setigerous, with a few long setæ on each lateral corner, several minute setæ on caudomeson near anal point, a large brown V-shaped band on surface; anal point highly chitinized, with many small but distinct dots; coxite large, scantily setigerous, with three slender hairs on ventromesal margin; style rather slender, not sharply pointed, with ten or more setæ on lateral side, many slender short hairs on mesal side; dorsal appendage large, prominent, walnutlike, with several minute setæ on dorsal side and a few similar setæ on mesal side; its accessory lobe small, clawlike, not extending beyond dorsal lobe; intermediate appendage as large as style, crowned with many curved setæ, extending at middle of style; ventroproximal appendages very small, entirely setigerous with simple hairs. Legs without beards; foreleg ratio about 1.5; fore tibia with a small fixed spine which is shorter than diameter of tibia; four posterior legs each with two small

tibial combs; combs widely separated from each other, each with a spur; spurs of one leg unequal in length; shorter spur twice as long as comb, longer one 2.5 times as long as comb; empodium as long as claws, slender; pulvilli present, very small,

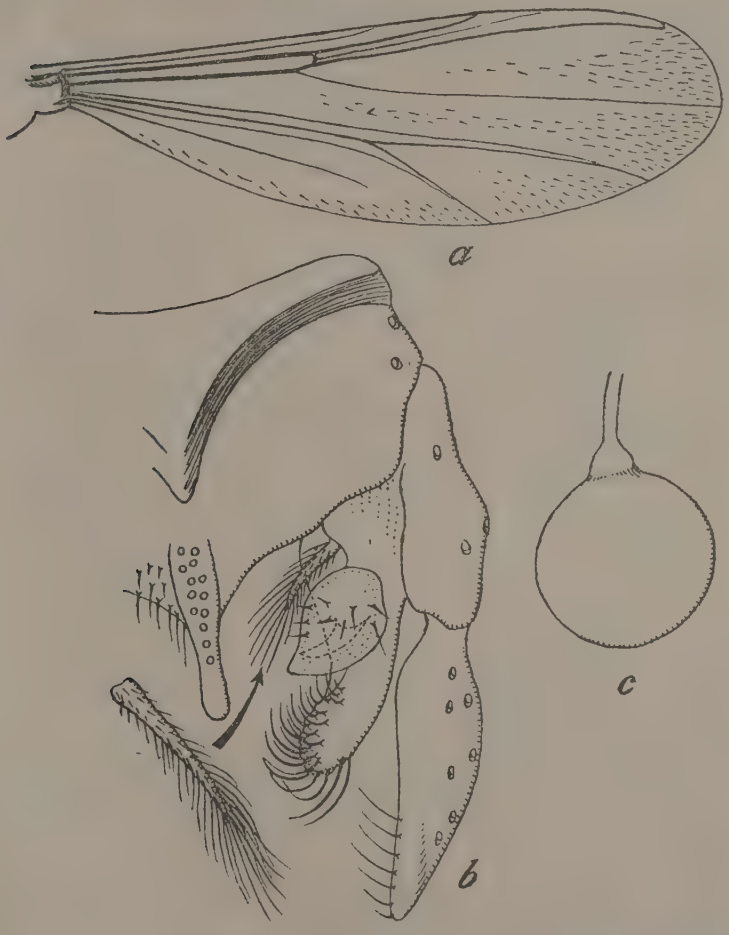


FIG. 24. *Tanytarsus (Tanytarsus) atagoensis* sp. nov. *a*, Female wing; *b*, male hypopygium; *c*, spermatheca.

with minute hairs. Wings (text fig. 25) very narrow, 1.5 to 1.6 millimeters long, with macrotrichia comparatively scarce; fringe of anal margin long; anal angle completely atrophied; R_{4+5} ending beyond level of tip of M_{3+4}, about twice as long as R_1; fMCu far beyond r-m; 1st A reaching fMCu.

Female.—Body 1.5 to 1.6 millimeters long, far paler than in male, yellowish white in general appearance; thoracic vittæ, sternum, and postscutellum pale brown. Eyes widely separated from each other; distance between them about 1½ times vertical length of eye; frontal tubercles very minute and papilliform. Antennæ 5-segmented; ultimate segment slightly shorter than two preceding segments taken together (7 : 4+4), usually with an apical seta; segment two shallowly constricted, slightly longer than following segment (5 : 4). Thorax with one supra-alar seta. Hypopygium scantily haired; ultimate sternum with a shallow V-shaped incision; cerci very small, sometimes almost completely atrophied, represented only by a blunt elevation of integument; spermathecæ (text fig. 24, *c*) spherical, hyaline. Wings (text fig. 24, *a*) about 1.4 to 1.5 millimeters long, comparatively broader and more hairy than in male; vein R_{4+5} ending on level of tip of $M_{3,4}$. Other structures of head, wings, and legs as in male.

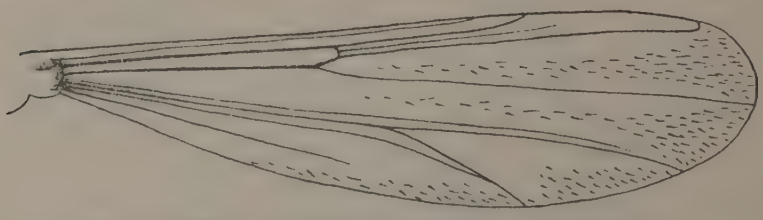


FIG. 25. *Tanytarsus* (*Tanytarsus*) *atagoensis* sp. nov. Male wing.

Habitat.—Mountainous region; Honshu, Japan.

Holotype.—Male; Mount Atago, Kyoto; May 31, 1931.

Allotopotype.—Female; May 31, 1931.

Paratopotypes.—Males and females; May 31, 1931.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

T. curticornis Kieffer is closely allied to the present species, which, however, has the antennal ratio of the male 0.8, and the foreleg ratio 2.

TANYTARSUS (TANYTARSUS) URAIENSIS sp. nov.

This species is peculiar in habitat, being found in hot springs of mineral water.

Male.—Body about 2.7 millimeters long, uniformly yellow or pale brown. Antennæ 14-segmented; antennal ratio about 1.2 (32 : 27) maxillary palpus with four distinct segments (2 : 5 : 6 : 9.5). Thorax with a line of setæ along pseudosutural fo-

veæ and two short lines of setæ on cephaloscutal area, supra-alar setæ one, rarely two; scutellum with a pair of median and two pairs of lateral setæ. Fore tibia with a distinct immovable apical spine; relative lengths of fore femur and tibia 43 : 27; hind tibial combs very narrowly separated, each with a spur; empodium slender, as long as claws; pulvilli minute, setigerous. Wing (text fig. 27, *a*) hyaline, with macrotrichia on middle part of cell R_5 and on apical part of M_2; R_{2+3} ending on costa just before the middle between ends of R_1 and R_{4+5}. Abdomen slender; hypopygium (text fig. 26) with ultimate tergum very sparsely setigerous, with a V-shaped chitinization; anal point with a dotlike impression, with apical lamella; dorsal appendage thinly membranous, setigerous, with a very indistinct accessory lobe; ventral projection slender, with a tuft of slender setæ on apical end.

FIG. 26. *Tanytarsus (Tanytarsus) uraiensis* sp. nov. Male hypopygium.

Female.—Body length 2 millimeters; in coloration similar to male. Head with eyes bare, reniform, widely separated on vertex, the distance between eyes slightly wider than half of vertical length of eyes (8 : 14); frontoclypeus highly setigerous; antenna 5-segmented (4 : 6 : 4 : 4.5 : 9.5); intermediate segments each with a neck region very short; maxillary palpus with four distinct segments (2 : 4.8 : 6 : 10). Wing (text fig. 27, *b*) with macrotrichia uniformly spread over wing cells R_5, M_2, M_4, and anal cell. Foreleg with proportional lengths of seven distal segments 35 : 24 : 54 : 25 : 20 : 17 : 8. Abdomen with ultimate sternum highly setigerous, with a deep U-shaped incision, cercus (text fig. 27, *c*) somewhat rectangular; spermathecæ (text fig. 27, *d*) two, pale brown, short-oval.

Pupa.—Body about 5 millimeters long; exuviæ almost colorless, hyaline. Head with two pairs of pointed tubercles larger on frontal region, and smaller on scape of antenna. Thoracic respiratory organ (text fig. 27, *e*) slender, with small hairs on one

side. Abdomen hyaline; first tergum without cuticular processes; second tergum with a broad median dark area, a spinous welt on anterior part, minutely spinous small area on posterior

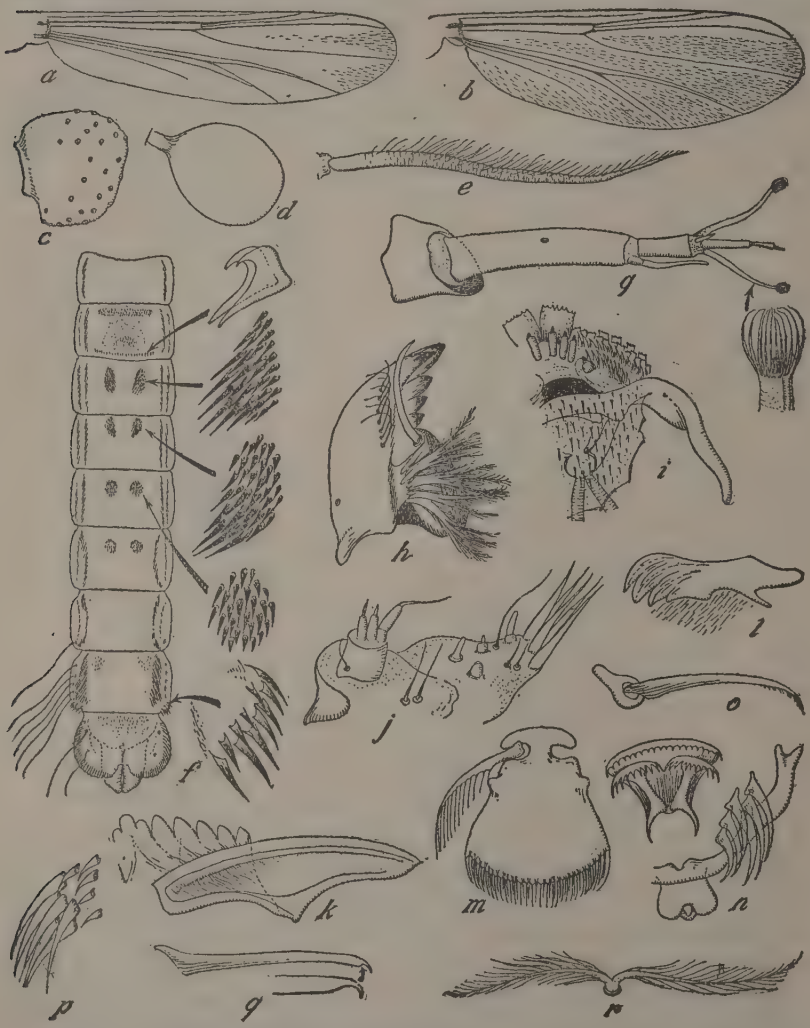


FIG. 27. *Tanytarsus* (*Tanytarsus*) *uraiensis* sp. nov. *a*, Male wing; *b*, female wing; *c*, female cercus; *d*, spermatheca; *e*, thoracic respiratory organ of pupa; *f*, dorsal side of pupal abdomen; *g*, larval antenna; *h*, larval mandible; *i*, larval hypopharynx; *j*, larval maxilla; *k*, larval mentum; *l*, larval premandible; *m*, distomesal appendage of larval epipharynx; *n*, median and midproximal appendages of larval epipharynx; *o*, distal appendage of larval labrum; *p*, laterodistal appendages of larval labrum; *q*, hooklet of anterior pseudopod of larva; *r*, plumose hair of larval abdomen.

part, and a line of thornlike spines (text fig. 27, *f*) on caudal margin; terga from third to sixth each with a pair of spinous patches on anterior part; these spinous patches larger on an-

terior segments; seventh tergum with a long lateral swimming hair on either caudal corner; eighth tergum with a pair of dark linear areas on lateral sides, a pair of minutely spinous small areas on anterior part, about eleven strong isolated spines on either laterocaudal corner, five slender swimming hairs on either lateral side; ultimate segment with a pair of hemicircular swimming paddles fringed with about thirty-seven slender swimming hairs on either margin, and two pairs of long isolated setæ on lateral sides; dorsal side of ultimate segment with a minutely spinous area on anterior part.

Larva.—Body about 7 millimeters long, without special strong setæ. Head with three chitinized plates of clypeus, three pairs of distinct setæ on these plates, paired chitinized clypealiæ, tormæ, and labraliæ; premandible (text fig. 27, *l*), with four apical teeth; distal labral appendage (text fig. 27, *o*) slender, very minutely serrulate at apex, with a basal ring; laterodistal labral appendages (text fig. 27, *p*) consisting of six strong and five small simple thorns; epipharynx with following cuticular appendages: Distomesal appendage (text fig. 27, *m*) consisting of a pair of plumose projections and a broad scalelike plate; median appendage consisting of a pair of strong hooklike projections and a broad minutely serrulate plate; midproximal appendage (text fig. 27, *n*) consisting of a V-shaped thickening, a small median trapezoid plate, and six spinelike solid projections along each arm of V-shaped thickening. Antenna (text fig. 27, *g*) slender, 5-segmented, basal antennal projection bluntly ended, segment one longest, longer than four following segments taken together, with a distinct sensory projection at end; segment two with two long and a short sensory projection at end; segment three simple, slightly shorter than preceding; segment four simple, about half as long as preceding; segment five very minute, conical. Mandible (text fig. 27, *h*) with two apical and three cutting teeth, a strong hyaline setalike projection on cutting edge, distal brustia of several simple setæ, proximal brustia of three plumose hairs and a group of hyaline setalike projections. Maxilla (text fig. 27, *j*) consisting of an inner lobe which carries five hyaline apical spines, three sensory setæ, and four peglike sensillæ, and an outer lobe which carries two setæ and a palpus; maxillary palpus 4-segmented, with two sensory projection on distal end of first segment. Labium (text fig. 27, *k*) with a pair of large submenta, a pair of simple setæ near the former; mentum with five pairs of lateral teeth and a triple median tooth; labial appendages atrophied. Hypopha-

rynx (text fig. 27, *i*) supported by a large chitinized pharyngealingula; its anterior membranous lobe with a pair of distinct scalelike median lamellæ, many minute comblike scales on ventral side, four pairs of peglike sensillæ, and a number of minute spines on dorsal side, many spines on posterior dorsal membrane; paired salivary ducts united just before salivos, common duct absent. Anterior pseudopod with numerous simple hooklets of similar size and shape (text fig. 27, *q*); typically abdominal segments each with a pair of lateral bifurcate plumose hairs (text fig. 27, *r*) on caudal part; caudal tuft of setæ composed of a small basal tubercle, eight long apical setæ and two preapical minute setæ; apical setæ arising from a common basal ring-shaped thickening; posterior pseudopod with sixteen simple hooklets; anal gills two pairs of ordinary lobes.

Habitat.—Hot spring water; Formosa.

Holotype.—Male; Urai-Onsen, Formosa; September 14, 1924.

Allotopotype.—Female; September 14, 1924.

Paratopotypes.—Males and females; September 14, 1924.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. R. Takahashi.

This species is somewhat similar to a Formosan species, *Rheotanytarsus formosæ* Kieffer, in which, however, the antennal ratio of the male is about 1, the wing of the female is less hairy, and the foreleg ratio is about 2.

TANYTARSUS (TANYTARSUS) PELAGICUS Tokunaga.

This marine midge has been reported from Seto, Wakayama.[2] In 1936 I collected a male pupa at Ebisu, Tomioka, Amakusa Islands, Kyushu.

Pupa.—Closely related to pupa of *T. boodleæ* Tokunaga. Body about 2.5 millimeters; head, thorax, and genital sheaths pale brown; other parts colorless, hyaline. Thorax without respiratory organs. Abdominal terga from second to sixth each with a pair of spinous patches, patches brown, oval, comparatively large, subequal in size in all segments, consisting of numerous minute spinules; second terga with a caudal straight row of simple hooklets; abdominal segments, except ultimate segment, without both lateral swimming lamellæ and lateral long swimming hairs; penultimate segment with a pair of small caudal hornlike projections (text fig. 28); ultimate segment small, with

[2] Tokunaga, M., Philip. Journ. Sci. 51 (1933) 364–366.

many lateral swimming hairs, two pairs of very long lateral isolated setæ; genital sheaths distinctly projected caudad far beyond caudal margin of ultimate tergum.

Habitat.—Seashore, under low-tide mark; Japan.

Specimens.—An alcoholic male pupa; Ebisu, Tomioka, Amakusa, Kyushu; October 28, 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

FIG. 28. *Tanytarsus (Tanytarsus) pelagicus* Tokunaga. Caudolateral spine of eighth abdominal segment of pupa.

TANYTARSUS (RHEOTANYTARSUS) PENTAPODA Kieffer.

This species is very common in running water in Kyoto. The larval nest cases are characteristic, being provided with several tentaclelike filaments.

Male.—Body 2 to 2.2 millimeters long; ground color white; thorax with four yellowish vittæ; wing without anal lobe. Head yellowish brown, with eyes bare, without frontal tubercles; frontoclypeus yellowish brown, setigerous, with about twenty-four yellow setæ. Antenna with scape yellowish white, flagellum and plumose hairs pale brown, 14-segmented; ultimate three or four segments sometimes incompletely segmented; antennal ratio 0.7 (0.68 to 0.72). Maxillary palpus yellowish brown, 5-segmented (1.3 : 2 : 5.5 : 6.1 : 11.3). Thorax extensively white; scutum with two short yellowish white median and two long yellowish brown lateral vittæ; scutellum with two pairs of long lateral and a pair of short median setæ on anterior margin, and two long median setæ on meson; postscutellum with an obscure yellowish brown cloud on caudal part; sternal side pale brown. Legs with coxæ and trochanters white, tibiæ and tarsi yellowish white; fore femur yellowish white on distal half and white on proximal half; middle and hind femora entirely white; tibial combs distinctly separated, each with a spur, pulvilli absent; empodium very slender, hairlike; beards absent; proportional lengths of segments of legs 42 : 19 : 49 : 25 : 19 : 16 : 7 in foreleg, 47 : 23 : 55 : 27 : 21.5 : 17.2 : 7.5 in middle leg, and 42 : 21 : 50 : 25 : 19 : 16 : 7 in hind leg; foreleg ratio about 2.6. Wing (text fig. 29, *a*) with macrotrichia spread over entire surface, fringed with long setæ, without anal lobe; crossvein very short; R_{2+3} indistinct; R_{4+5}

slightly curved along costal margin; fMCu far beyond level of crossvein, but before middle of wing. Abdomen entirely white; hypopygium (text fig. 29, *b*) with anal point long, ultimate ter-

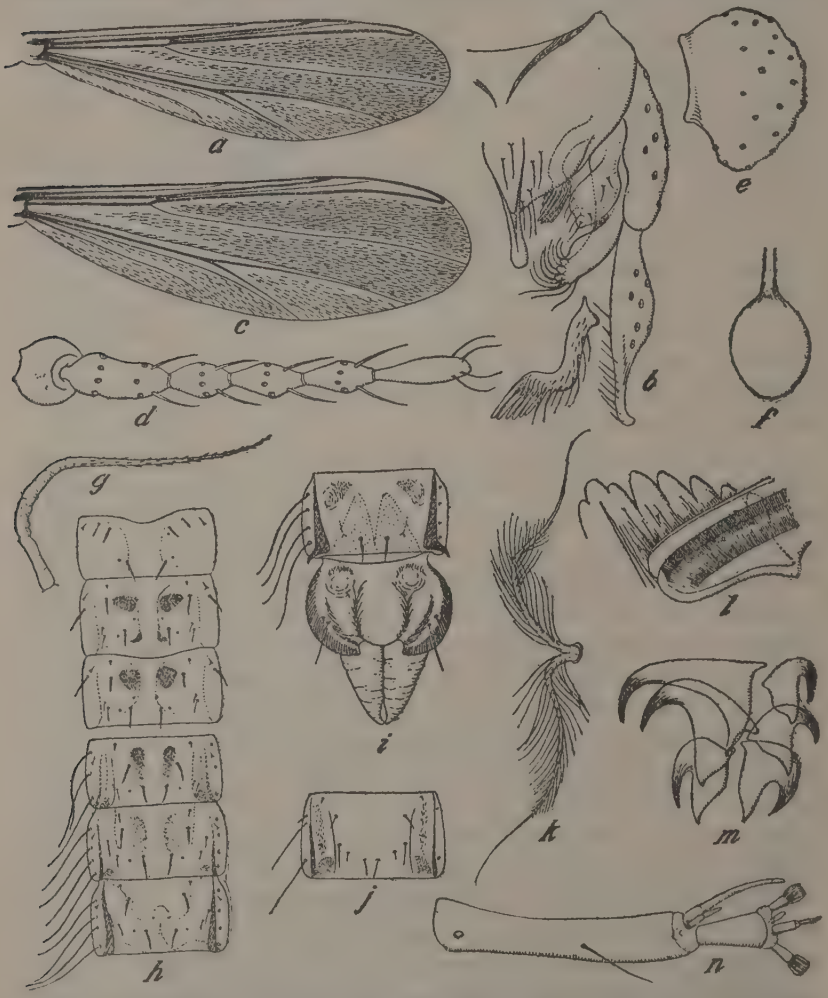


FIG. 29. *Tanytarsus* (*Rheotanytarsus*) *pentapoda* Kieffer. *a*, Male wing; *b*, male hypopygium; *c*, female wing; *d*, female antenna; *e*, female cercus; *f*, spermatheca; *g*, thoracic respiratory organ of pupa; *h*, dorsal side of abdominal segments of pupa (segment four omitted); *i*, caudal end of pupal abdomen; *j*, ventral side of abdominal segment four of pupa; *k*, plumose hair of larval abdomen; *l*, larval mentum; *m*, claws of posterior pseudopod larva; *n*, larval antenna.

gum very scantily setigerous; style very long, with apical half very narrow, distinctly curved ventrad, forming a hook; dorsal appendage swollen, without accessory projections; intermediate

appendage strongly curved mesad, with many curved setæ on apex; ventral appendage suddenly angulated distally with many flattened projections on apex and long pubescence on stem.

Female.—Body about 1.5 to 1.8 millimeters long; coloration as in male. Antenna mainly yellowish white, with ultimate segment pale brown, 6-segmented; intermediate flagellar segment short-fusiform; ultimate segment with about four apical hairs, without strong basal setæ; proportional lengths of antennal segments, 3 : 5 : 3 : 3.2 : 3 : 4.5. Maxillary palpus 5-segmented (2 : 2 : 6 : 6.5 : 12). Proportional lengths of segments of legs 44 : 22 : 54 : 26.5 : 20 : 17 : 7.3 in foreleg, 41 : 32 : 18 : 8 : 6 : 4.3 in middle leg, and 45 : 38 : 24 : 15 : 12 : 7 : 4.5 in hind leg. Wing (text fig. 29, *a*) with macrotrichia thicker than in male; R_{2+3} very obscure; venation as in male. Cercus (text fig. 29, *e*) white, setigerous; spermathecæ (text fig. 29, *f*) two, oval, colorless, with long neck regions. Other structures mainly as in male.

Pupa.—Body length about 3 to 3.5 mm; exuviæ mainly colorless and hyaline, head and thoracic regions dark. Head with a pair of long setæ between antennæ; vertexal region finely imbricate; antennal base with a ring of minute spinules; sheath of paraglossa with an apical filamentous projection. Thorax with a pair of filamentous respiratory organs (text fig. 29, *g*) which are finely spinulous on distal half; middorsal area of scutum finely imbricate; pronotal region with two long flattened setæ on either side; scutum with three long setæ near respiratory organ and small setæ on mesal area. Abdomen (text fig. 29, *h* to *j*) with lateral swimming lamellæ on fourth to eighth segments, paired spinous patches on dorsal side of segments two to five. Typical chætotaxy of abdominal tergum: One pair of minute setæ on anterior margin, one pair of small flattened setæ on anterior region, two pairs of small slender setæ on posterior region, one pair of small flattened setæ near posterior margin, one pair of minute sensory pores on middle part and posterior margin; sternum: One pair of minute setæ on anterior margin, one pair of small setæ on anterior or middle region, three pairs of small slender setæ on posterior margin; lateral side with variable number of setæ; in first, eighth, and ninth segments setæ more or less reduced; first tergum without two pairs of caudal small setæ; eighth tergum with only one pair of caudal flattened setæ; first sternum with only two pairs of anterior setæ; eighth sternum without three pairs of posterior setæ; seg-

ment one without lateral setæ; segments two and three each with a large dorsal, two small ventral setæ on either lateral side; segment four with a large dorsal seta and a small and a long ventral setæ on either side; segment five with three long ventral setæ on either side; segments six to eight each with four long ventral setæ on either lateral lamella. Caudal ridge of spines of second tergum consisting of curved simple hooklike spines arranged in a line; spinous patches of fifth tergum very small; caudal spines of segment eight simple; ultimate segment with shallow caudal incision, a pair of dorsal and ventral setæ on

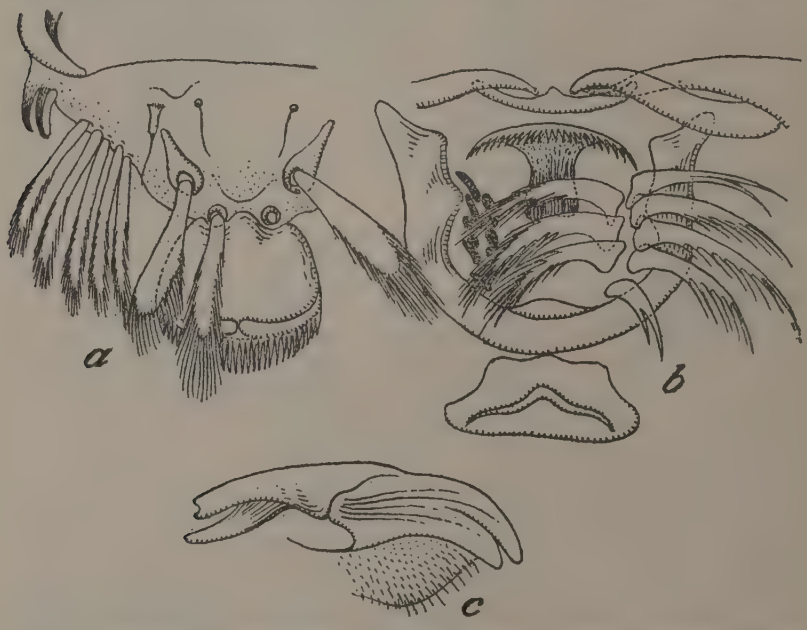


FIG. 30. *Tanytarsus* (*Rheotanytarsus*) *pentapoda* Kieffer. *a*, Larval labrum; *b*, larval epipharynx; *c*, larval premandible.

lateral lamellæ, about twenty-five swimming hairs on either side; genital sheaths extending caudad far beyond ultimate segment in both sexes.

Larva.—Body about 3.2 to 3.7 millimeters long. Head oval, with two clypeal plates; antenna (text fig. 29, *n*) arising from a basal large projection, 5-segmented; segment one long, about twice as long as the remaining segments taken together; segment two with two Lauterborn organs and a small sensory projection on its distal end; trichoid sensilla on distal end of first segment ending far before antennal tip. Labrum (text fig.

30, *a*) with two small scalelike and five large plumose appendages on either lateral side, one pair of slender setæ, one pair of peglike sensillæ, and one pair of large plumose appendages on mesal area, one pair of large plumose appendages and one large comblike plate on distomesal area; epipharynx (text fig. 30, *b*) with a pair of large bidentate premandibles (text fig. 30, *c*) a large fanlike serrulate plate on mesal area, and complex midproximal appendages composed of a large U-shaped thickening, a large subtrapezoid plate, and two groups of eight plumose hooklike appendages. Labium (text fig. 29, *l*), with a pair of large submenta, a thickened dentate mentum, and a pair of single simple setæ; mentum with a large unpaired median tooth which bears small shoulder parts, and five lateral teeth on either side. Mandible with a slender apical tooth, five cutting teeth, a very long trichoid projection on base of cutting edge, many slender hairs on distal brustia, five plumose hairs on mesal side, and two isolated setæ on lateral side. Maxilla with two large trichoid projections on inner lobe, a large palpus, and a large sensory disc on outer lobe. Anterior pseudopod with numerous nonserrulate simple hooklets; posterior pseudopod with sixteen simple yellow claws (text fig. 29, *m*); caudal tuft of setæ consisting of seven long setæ and two minute setæ arising from a small common tubercle; a pair of two-branched plumose hairs (text fig. 29, *k*) on lateral sides of second to sixth abdominal segments; anal gills short-oval.

Nest case.—Polygonal and cylindrical, closely applied on substratum (that is, stones, plants, and other material) with its slender basal part; free larger part of case with five or six, rarely eight, tentaclelike filaments on margin; external surface of case with several longitudinal ridges; pupal nest case with filaments short, an operculum which is very thin, hyaline, with many concentric circular lines and a small central opening; in nest case of young larva both ends often with two or four filaments, and closely applied on substratum with entire lengths of case; number of filaments corresponding to that of external longitudinal ridges.

Habitat.—Running water.

Specimens.—Alcoholic; Kitashirakawa, Kyoto; October 8 to 30, 1935 and 1936; deposited in the entomological laboratory, Kyoto Imperial University; collected by Mr. T. Kani and M. Tokunaga.

TANYTARSUS (RHEOTANYTARSUS) ÆSTUARIUS sp. nov.

This midge was found at the estuary of a river, Tottori Prefecture.

Male.—Body 2.7 to 2.8 millimeters long, setigerous, brown in general appearance; thorax and legs yellowish brown; antennæ, thoracic dorsal vittæ, sternal side, postscutellum, and tips of femora all reddish or dark brown; abdomen with brown bands on caudal margin of each tergum from first to sixth; thoracic dorsal vittæ and postscutellum distinctly separated by pale longitudinal lines; middorsal vittæ far shorter than lateral vittæ; halteres and abdominal sternal side yellowish white. Frontal tubercles absent; eyes bare, not widely separated from each other; distance between them about half vertical length of eye (18 : 35); maxillary palpi long, distinctly 4-segmented (4 : 7 : 8 : 14); antennæ 14-segmented, with four distal segments incompletely segmented; antennal ratio about 1; ultimate segment with a short apical seta. Supra-alar seta always only one; scutellum with a pair of median and two pairs of lateral long setæ. Hypopygium (text fig. 31, *c*) setigerous, with anal point long, thickened, with a large cavity between the two dorsal lamellæ; setæ on ultimate tergum very scanty, small, found only on caudal margin and base of anal point; coxite with four stiff setæ on thickened ventromesal margin; style sharply pointed, directly extending caudad, very narrow on caudal part; dorsal appendage thinly membranous, elongated caudad, with several

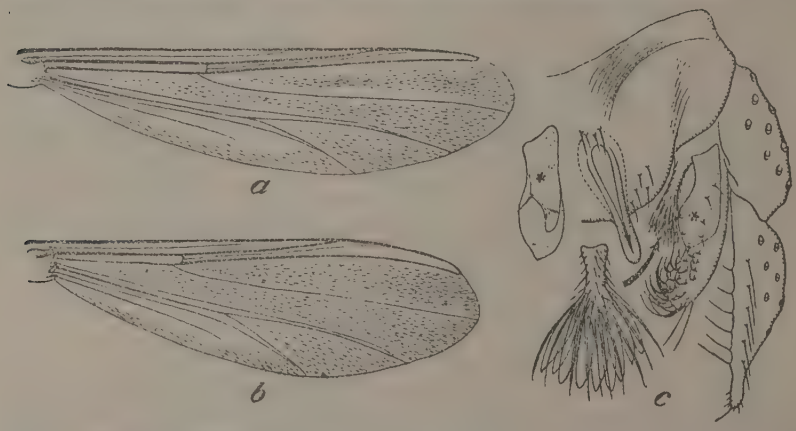


FIG. 31. *Tanytarsus* (*Rheotanytarsus*) *æstuarius* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium.

minute setæ on dorsal surface; accessory lobe of dorsal appendage wanting; intermediate appendage large, with a few setæ extending directly caudad, and many curved setæ on distal end; ventroproximal appendage with short pubescent stem and a long tuft consisting of simple hairs and flat hyaline hairs. Legs without beards; foreleg ratio about 2; fixed tibial spine of foreleg minute; four posterior legs each with two large combs distinctly separated from each other and occupying fully half circumference of tibial end; combs provided with long spurs twice as long as combs; claws simple, slender; empodium also slender, as long claws; pulvilli wanting. Wings (text fig. 31, *a*) narrow, about 2 millimeters long, with macrotrichia spread over entire surface, brown under transmitted light, fringed with long hairs on anal margin; anal angle greatly atrophied; $R_{4,5}$ about one and half times as long as R_1 (70 : 43), ending far beyond level of tip of Cu_1; $M_{1,2}$ long, twice as long as medial stem (80 : 35); fMCu far beyond level of basal section of Rs, very narrow.

Female.—Body distinctly shorter than in male, 1.9 to 2 millimeters long; coloration far paler than in male; head, thorax, and legs pale brown, thoracic dorsal vittæ and postscutellum reddish brown; femoral ends brown; abdomen without brown bands, uniformly yellow. Head with frontal tubercles papilliform; maxillary palpi short (3 : 6 : 7 : 12). Antennæ 6-segmented (18 : 35 : 24 : 25 : 25 : 34); segment two deeply constricted; distal segment subequal in length to segment two, fusiform, without apical setæ, but pubescent on distal half; ultimate sternum of abdomen broad, setigerous on caudal half, with a shallow caudal U-shaped incision; cerci (text fig. 32, *a*) setigerous with small setæ on lateral side, angulated ventrally; spermathecæ (text fig. 32, *b*) two, hyaline, oval, with slightly swollen neck region. Fixed tibial spine of foreleg comparatively long, but not longer than $\frac{1}{3}$ diameter of tibial end. Wings (text fig. 32, *b*) 1.8 to 1.9 millimeters long, broader than in male, somewhat angulated

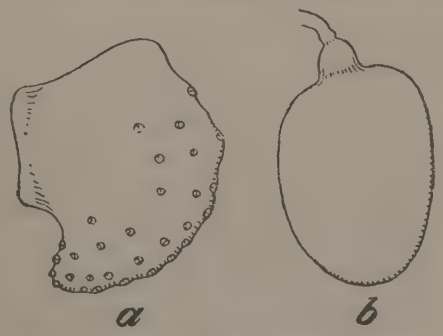


FIG. 32. *Tanytarsus* (*Rheotanytarsus*) *æstuarius* sp. nov. *a*, Female cercus; *b*, spermatheca.

on the anal margin at tip of Cu_1; vein R_{4+5} far longer than $1\frac{1}{2}$ times R_1 (7 : 4), M_{1+2} very long, slightly shorter than thrice medial stem (8 : 3); fMCu broader than in male. Other structures of head, thorax, wings, and legs as in male.

Habitat.—Estuary of river; Honshu, Japan.

Holotype.—Male; Karo, Tottori Prefecture; October 18, 1930.

Allotopotype.—Female; October 18, 1930.

Paratopotypes.—Males and females; October 18, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by Dr. Hachiro Yuasa and M. Tokunaga.

This species is allied to *T. raptorius* Kieffer, in which, however, the middle tibia has only one spur.

TANYTARSUS (MICROPSECTRA) FOSSARUM sp. nov.

This species is very common in the field in Kyoto.

Male.—Body 3.8 to 4.1 millimeters long, slender, uniformly dark; dorsal vittæ not distinct, but separated by lines of pale dots arranged along middorsal suture and pseudosutural foveæ; halteres yellowish white; abdomen uniformly dark brown. Frontal tubercles present, minute, conical; eyes bare, narrow, projected dorsad; distance between them half as wide as the vertical length of eye; clypeus black with many long brown setæ; maxillary palpus slender, long, distinctly 4-segmented (4 : 13 : 12 : 20); antenna 14-segmented; antennal ratio about 1.3; distal segment with two or rarely one small apical seta. Supra-alar setæ three, dark; scutellum with one pair of middle long setæ and four or three pairs of short setæ on its cephalic region. Abdomen with dark setæ; ventral side paler than dorsal side; ultimate tergum with a dark V-shaped thickening, a large anal point, several minute setæ on caudomesal margin, several small tuberculate setæ on its caudomeson, and a pair of small membranous tubercles on lateral sides; ultimate sternum very narrow, without setæ; coxite with three small setæ on ventromesal margin; style long, slender in lateral aspect but broad and truncate obliquely in dorsal aspect; dorsal appendage dark brown, somewhat triangular, expanded dorsad, with minute setæ on distal part; its accessory lobe slender, sinuous, extending mesad beyond tip of dorsal lobe; tip of intermediate appendage with many strong recurved setæ; ventroproximal appendage slender, entirely setigerous, extending caudad as far as intermediate appendage, with many curved spoonlike hairs on dorsal side of

distal part (text fig. 33, *c*). Legs without beards; foreleg ratio about 1.6 to 1.7; foreleg with one minute fixed tibial spine; posterior four legs with broad tibial combs which are completely confluent and occupy about three-fourths circumference of tibial end; claws simple; empodium slender, as long as claws; pulvilli wanting. Wings (text fig. 33, *a*) about 3.5 millimeters long, not distinctly narrow, slightly brown under transmitted light, with macrotrichia dark, very thick; anal margin fringed with long setæ; anal angle almost atrophied; R_{4+5} ending far beyond level of tip of M_{3+4}, curved along costal margin, a little shorter than twice R_1 (78: 43); r-m about thrice as long as basal section of Rs; fMCu narrow, a little beyond proximal end of r-m or

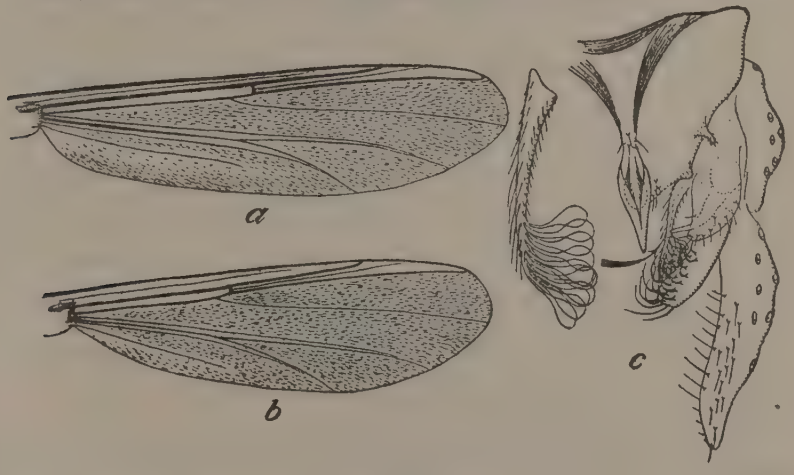


FIG. 33. *Tanytarsus* (*Micropsectra*) *fossarum* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium.

far before basal section of Rs; M_{3+4} gradually bent caudad; Cu_1 slightly sinuous; 1st A a little beyond base of fMCu.

Female.—Body 3.2 to 3.6 millimeters long; dark as in male; abdomen dark brown; halteres yellow; cerci yellowish brown; eyes broader and shorter than in male; distance between them a little narrower than vertical length of eye (11 : 15); maxillary palpi longer than in male, distinctly 4-segmented (4 : 11 : 13 : 23); antennæ 6-segmented; segment two constricted at middle, twice as long as scape; ultimate segment longer than any of remaining fusiform flagellar segments (49 : 40), subequal in length to second, with a small apical seta. Ultimate sternum

broad, setigerous on laterocaudal parts, with a U-shaped caudal incision; cerci (text fig. 34, *a*) with many small setæ on lateral side, subrectangular; spermathecæ (text fig. 34, *b*) hyaline, oval, with small neck region. Wing (text fig. 33, *b*) about 2.8 to 2.9 millimeters long, comparatively broader than in male; anal angle obscurer than in male; relative lengths of veins R_1 and R_{4+5} about 16 : 9. Other structures of head, thorax, wings, and legs highly similar to those of male.

Habitat.—Stagnant water; Honshu, Japan.

Holotype.—Male; Kitashirakawa, Kyoto; June 15, 1934.

Allotopotype.—Female; June 15, 1934.

Paratopotypes.—Males and females; June 2 to 15, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

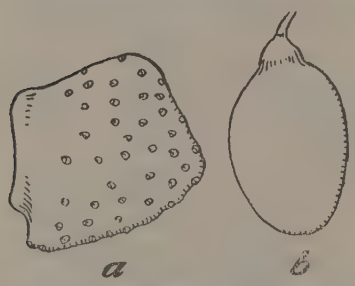


FIG. 34. *Tanytarsus* (*Micropsectra*) *fossarum* sp. nov. *a*, Female cercus; *b*, spermatheca.

This midge is very closely allied to *T. subviridis* Goetghebuer, in which, however, the thorax is yellow or pale brown and equipped with yellow vittæ, and the apical hairs of the ventroproximal appendages of the male hypopygium are pinheadlike, their apical swellings being smaller than in the present species.

TANYTARSUS (MICROPSECTRA) DAISENENSIS sp. nov.

This species was collected at a light screen at Mount Daisen, Hooki.

Male.—Body 3.3 to 3.4 millimeters long, very slightly yellowish white in ground color, with white setæ; flagella of antennæ and spiracles of thorax pale brown; frontal tubercles obscure; eyes narrowly extending dorsad, reniform, bare; distance between them about two-thirds vertical length of eye; clypeus setigerous, with about twenty or twenty-five long setæ; maxillary palpi long, slender; ultimate segment very slightly shorter than preceding two taken together (18 : 10+11); scape white; antennal ratio about 1. Scutum setigerous; dorsal vittæ obsolete. Supra-alar setæ three to five; scutellum with five pairs of setæ, middle pair long and very closely situated to each other on caudal region, other pairs arranged in a transverse line along cephalic margin, most lateral pair very small; rarely cephalic setal line of scutellum represented by only three pairs. Ab-

domen setigerous, slender; hypopygium (text fig. 35, *b*) setigerous, with brown setæ; ultimate tergum very scantily haired, with a V-shaped thickening, a thickened anal point, several small setæ on caudal area. Coxite with three slender setæ on highly chitinized ventromesal margin; style slender, extending

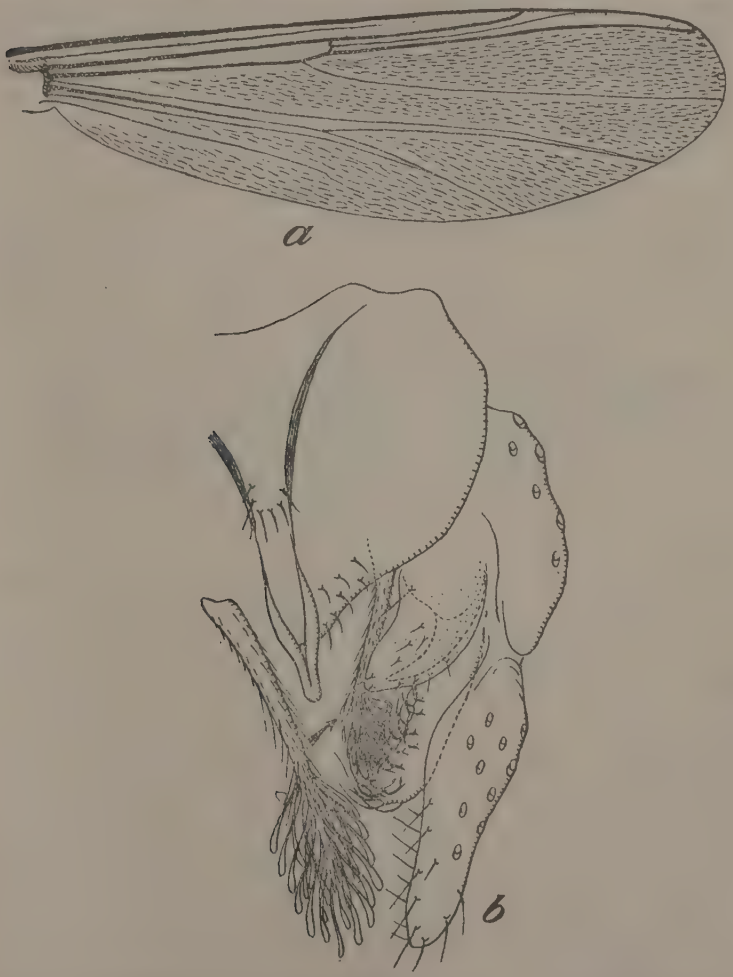


FIG. 35. *Tanytarsus* (*Micropsectra*) *daisenensis* sp. nov. *a*, Female wing; *b*, male hypopygium.

dorsocaudad, with many slender small setæ on mesal and ventral sides; dorsal appendage comparatively large, thinly membranous, expanded dorsomesad, bluntly ending, with several minute setæ on dorsal side and a stiff small seta on mesal side of

thickened basis; accessory lobe of dorsal appendage small, claw-like, not extending beyond dorsal appendage; intermediate appendage broad, with a blunt secondary dorsal projection on distal part, setigerous on dorsal and mesal sides and distal part; ventroproximal appendage slender, hardly as long as intermediate appendage, highly setigerous on chitinized stem, with many clavate curved hairs on distal half. Legs without beards; fore-leg ratio about 1.6 to 1.7; fore tibia with a very small fixed spine; posterior four legs with broad tibial combs which are completely confluent, occupying three-fourths of circumference of tibial end, without spurs; claws simple; empodium slender, as long as claws; pulvilli wanting. Wings (text fig. 36) 2.2 to 2.3 millimeters long, narrow, with very dense macrotrichia, slightly brown under transmitted light, with long marginal hairs; anal angle atrophied; vein R_{4+5} ending beyond level of tip of vein M_{3+4}, about twice as long as R_1 (11 : 6); r-m hori-

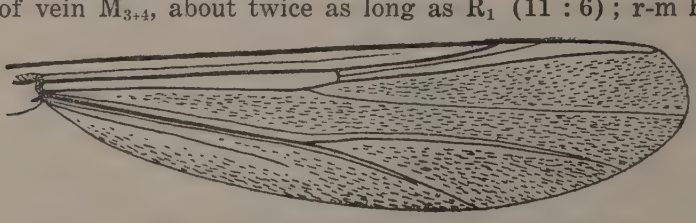


FIG. 36. *Tanytarsus* (*Micropsectra*) *daisenensis* sp. nov. Male wing.

zontal, twice as long as Rs; basal section of fMCu just caudad of r-m, very narrow, 1st A ending at base of fMCu.

Female.—Body 2.7 to 2.8 millimeters long; coloration similar to that of male but antennæ uniformly white; eyes broader than in male; maxillary palpi comparatively longer than in male; ultimate segment subequal to two preceding segments taken together (24 : 11 + 12); antennæ 6-segmented; segment two distinctly constricted; ultimate segment long, 1½ times as long as each of three preceding fusiform segments, with a long apical seta. Ultimate abdominal sternum broad, with many long setæ and a U-shaped caudal incision; cerci (text fig. 37) somewhat rectangular, with many small setæ on lateral side and a few setæ on mesal side. Wings (text fig. 35, *a*) larger than in male (2.6 to 2.7 millimeters long), comparatively broad; anal angle atrophied; vein R_{4+5} shorter than twice R_1 (15 : 8). Other structures of head, wings, and legs similar to those of male.

Habitat.—Mountainous region; Honshu, Japan.

Holotype.—Male; Mount Daisen, Tottori Prefecture; July 2, 1931.

Allotopotype.—Female; July 2, 1931.

Paratopotypes.—Males and females; July 2, 1931.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This fly is very closely similar to *T. brunnipes* Zetterstedt in the structures of the male hypopygium and antennæ, but easily distinguished from the allied species by the yellowish milky coloration of the thorax.

FIG. 37. *Tanytarsus (Micropsectra) daisenensis* sp. nov. Female cercus.

TANYTARSUS (LUNDSTRÖMIA) TELMATOPHILUS sp. nov.

This species is very abundant along marshes at Kyoto.

Male.—Body slender and fairly setigerous, 4 to 4.1 millimeters long; head, thorax, hypopygium, flagella of the antennæ, middle legs, and femora of forelegs and hind legs, uniformly brown; abdomen greenish pale brown; dorsal vittæ of thorax, postscutellum, pleural sclerites, forelegs distad of femora, and scapes on antennæ dark brown; hind legs distad of femora reddish brown; thorax shining. Frontal tubercles cylindrical, minute; eyes bare, narrowly elongated dorsad, not widely separated, distance between them on dorsal side about half vertical length of eye; clypeus with many long brown setæ. Antennæ 14-segmented; distal joint with one, rarely two, short apical setæ; antennal ratio about 1.3; maxillary palpi long and slender, 4-segmented distinctly (17 : 10 : 9 : 4), with distal segment slightly longer than two preceding taken together. Scutum with many brown setæ arranged along middorsal suture and pseudosutural foveæ; supra-alar setæ two, but sometimes one and rarely three; scutellum with variable number of setæ (4 to 8). Ultimate tergum of abdomen very scantily haired, with a few minute setæ on caudomesal margin near base of anal point and about four minute setæ on caudal part, a large V-shaped thickening; coxite with four slender setæ on ventromesal margin; style slender, longer than coxite; dorsal appendage subtriangular, chitinized, dark brown, with several small setæ on dorsal side; accessory lobe clawlike; ventroproximal appendage small, short, but stout, seti-

gerous on stem, with an apical tuft of many bladelike hairs that are almost as long as the stem (text fig. 38, *c*). Legs without beards; fixed tibial spine of foreleg short, about half as long as diameter of tibial end; foreleg ratio about 1.5; posterior four legs with large tibial combs which are completely confluent; each leg provided with usually two spurs which are $1\frac{1}{2}$ times as long as comb (at least one spur remains conspicuously when the other is reduced in various degrees); claws simple; empodium as long as claws and slender; pulvilli wanting. Wings (text fig. 38, *a*) about 3.1 millimeters long, narrow, macrotrichia thick; membrane pale brown under transmitted light; anal angle almost atrophied; vein R_{4+5} ending far beyond level of tip M_{3+4}, shorter than twice R_1 (73 : 43); fMCu slightly beyond r-m, narrowly forked; M_{3+4} slightly sinuous at tip; 1st A reaching the base of fMCu.

Female.—Body 2.9 to 3 millimeters long; paler than in male: head, thorax, antennæ, and posterior four legs brown; abdomen pale brown; forelegs distad of femora reddish brown; dorsal vittæ of thorax, postscutellum, and sternum dark brown; pleural sclerites with two dark spots, one near wing basis and the other beneath basis of halter. Frontal tubercles conical, more pointed than in male. Eyes more broadly separated from each other than in male. Antennæ 6-segmented; distal segment with an apical seta, slightly longer than each of the preceding three segments (28 : 48 : 33 : 35 : 34 : 37). Maxillary palpi also slender, distinctly 4-segmented (20 : 51 : 52 : 96). Ultimate sternum broad, setigerous; caudal incision small, U-shaped, without macrotrichia on its margin but with many microtrichia; cerci (text fig. 38, *d*) small, somewhat rhombic, with short setæ on lateral side; spermathecæ (text fig. 38, *e*) two, hyaline, oval. Legs stouter than in male. Wings (text fig. 38, *b*) about 3.1 millimeters long, larger, comparatively broader, more densely covered with hairs than in male; vein R_{4+5} about 1.7 times as long as R_1 (80 : 47). Other structures of head, thorax, wings, and legs closely similar to those of male.

Habitat.—Stagnant water; Honshu, Japan.

Holotype.—Male; Kitashirakawa, Kyoto; March 14, 1932.

Allotopotype.—Female; March 14, 1932.

Paratopotypes.—Males and females; March 14, 1932, and November 31, 1935.

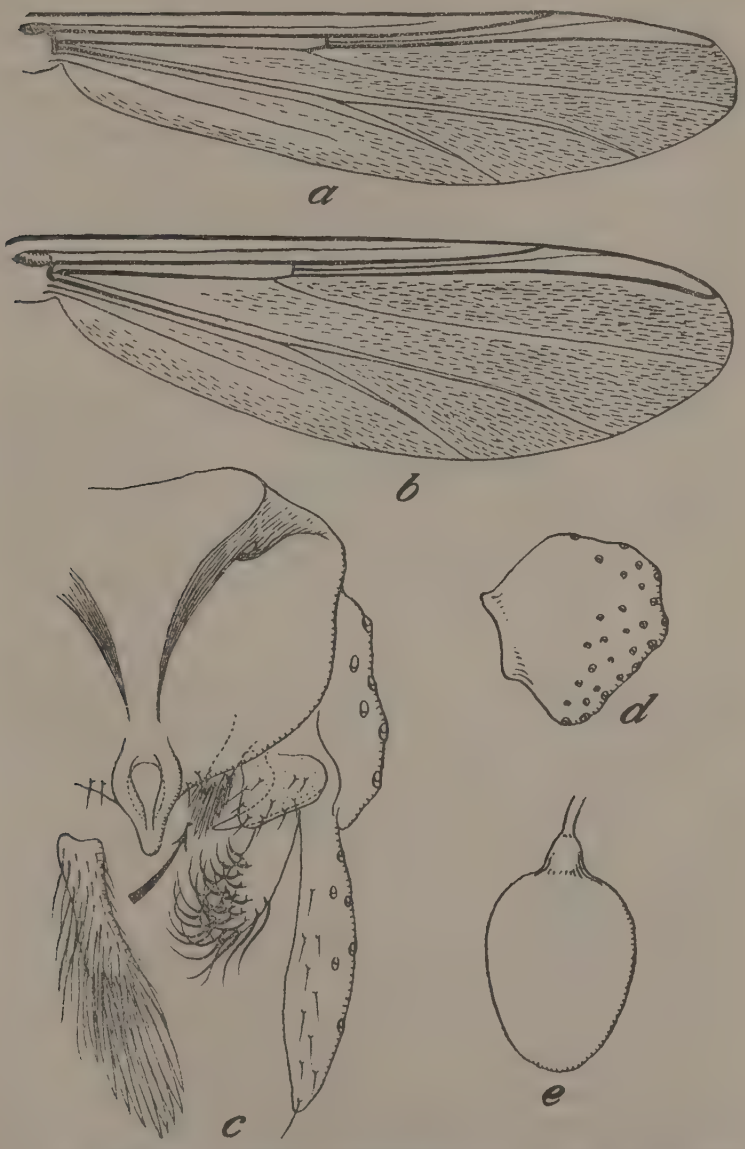


FIG. 38. *Tanytarsus* (*Lundströmia*) *telmatophilus* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus; *e*, female spermatheca.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is somewhat related to *T. lobatus* Kieffer and *T. bituberculatus* Edwards; in the first related species, however, the hypopygium of the male is distinctly different, the dorsal appendage being bare, petiolate, and oval on the distal end. The second species is provided with paired tubercles behind the anal point and very short ventroproximal genital appendages in the male, and the thorax is uniformly yellow or green in the female.

TANYTARSUS (LUNDSTRÖMIA) TREDECEMARTICULUS sp. nov.

This fly was collected along a rapid stream of Kibune, Kyoto.

Male.—Body about 2 millimeters long, slender, pale green in ground color; antennæ, scutal vittæ, sternal side of thorax, and postscutellum brown; pleuron with a brown spot near wing basis; scutal vittæ distinctly separated; supra-alar setæ two or three; scutellum with two pairs of long median and a pair of small lateral setæ. Frontal tubercles very minute, papilliform; eyes bare, reniform, widely separated from each other; distance between them subequal to vertical length; clypeus scantily haired; maxillary palpi long, 4-segmented (10 : 40 : 45 : 77); antenna long, 13-segmented; antennal ratio 0.32 to 0.35; ultimate segment with two or three apical setæ, subequal in length to three preceding segments taken together. Hypopygium (text fig. 39) slender, setigerous; ultimate tergum with several minute setæ on caudal margin and base of anal point; anal point thickened, slender, with a large dorsal cavity between thin lamellæ; coxite with four slender setæ on ventromesal margin; style elongated, triangular in lateral aspect; dorsal appendage hemispherical, with several minute setæ on dorsal surface; its accessory lobe slender, slightly beyond dorsal lobe; intermediate appendage large, broad, with many setæ on dorsal side of distal half, crowned with a strong

FIG. 39. *Tanytarsus (Lundströmia) tredecemarticulus* sp. nov. Male hypopygium.

curved seta; ventroproximal appendage with many spoonlike hairs on distal third. Legs without beards; fixed tibial spine of foreleg short, hardly half as long as diameter of tibial end; foreleg ratio about 1.6; four posterior legs each with a single broad comb which occupies about half or a little more than half of circumference of end of tibia; spur of comb about $1\frac{1}{2}$ the length of comb; claws simple, without pulvilli; empodium slender, as long as claws. Wings (text fig. 40) about 1.7 to 1.8 millimeters long, with macrotrichia spread over entire surface; anal angle quite atrophied; R_{1+5} slightly curved along costal margin, shorter than twice R_1 (80: 47), ending a little beyond level of tip of M_{3+4}; r-m long, twice as long as basal section of Rs; M_{1+2} twice as

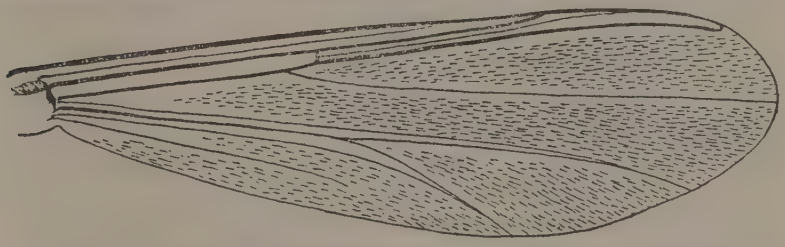


FIG. 40. *Tanytarsus* (*Lundströmia*) *tredecemarticulus* sp. nov. Male wing.

long as medial stem; fMCu very slightly beyond basal section of Rs, narrow; M_{3+4} and Cu_1 very slightly curved caudad at tip; 1st A short, hardly reaching base of fMCu.

Habitat.—Rapid stream; Honshu, Japan.

Holotype.—Male; Kibune, Kyoto; June 22, 1932.

Paratopotypes.—Males; June 22, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

The present species is quite characteristic in the extremely small value of the antennal ratio and the 13-segmented antennæ of the male. Similar characters of the antennæ are unknown among the known members of this subgenus so far as I am aware.

TANYTARSUS (STEMPELLINA) BICOLIOCULUS sp. nov.

This small midge is abundant along running water in Kyoto.

Male.—Body 1.7 to 1.8 millimeters long. Thorax yellowish brown; dorsal vittæ and sternal side reddish brown; middorsal vittæ distinctly separated by a pale line of dots along middorsal suture; lateral vittæ dark at caudal ends; pleuron with a brown

spot near wing basis; postscutellum reddish brown on caudal half. Antennæ brown, with scapes reddish brown; eyes black on ventral half and brown on dorsal half. Other appendages of head and thorax uniformly pale brown. Abdomen white; hypopygium pale brown. Eyes bare, reniform, bicolored, widely separated, distance between them on dorsal side far greater than vertical length of eyes (17 : 13); frontal tubercles present, very small, blunt, subtriangular; antennæ 11-segmented; antennal ratio about 0.6 (0.55 to 0.59); ultimate segment with two apical setæ, subequal in length to four or five preceding segments taken together; maxillary palpi slender, 4-segmented; ultimate segment slightly shorter than two preceding segments taken together (10 : 20 : 30 : 46). Clypeus not densely haired, with about fifteen to twenty setæ. Pronotum greatly reduced; scutum very scantily haired; middorsal vittæ short, ending at cephalic ends of lateral vittæ; supra-alar seta one, very rarely two; scutellum with a pair of distinct median setæ and two pairs of small lateral setæ. Abdomen also scantily setigerous, slender in general appearance; hypopygium (text fig. 41, *a*) not highly chitinized; ultimate tergum very scantily haired, with few very small setæ on caudal part; anal point not distinctly thickened, with very thin lateral ridges, and very fine pubescence; ultimate sternum without macrotrichia; coxites large, broad, with five slender setæ on ventromesal margin; style also broad, extending caudodorsad, ending in blunt broad tip in lateral aspect; dorsal appendage very thinly membranous, expanded dorsad, provided with a few minute setæ, extending mesad, ending in a blunt or sometimes more sharp pointed tip on which a few minute setæ are found; accessory lobe of dorsal appendage slender, smooth, somewhat clawlike; intermediate appendage stout, broad, with many small strong setæ at tip and on dorsodistal margin, without macrotrichia on stem; ventroproximal appendage slender, almost smooth at stem, with a tuft of simple hairs at tip. Legs without beards; foreleg ratio 1.8 to 1.9; fore tibia with a fixed apical spine as long as diameter of tibia; posterior four legs each with two small distinctly separate combs, occupying at most about one-third circumference of end of tibia; each comb with a distinct spur twice as long as comb; claws with a few minute setæ on basal part; empodium slender, slightly shorter than claws; pulvilli obscure. Wings (text fig. 42, *a*) 1.2 to 1.3 millimeters long, slightly brown under transmitted

light, fringed with long hairs on anal margin, with macrotrichia very scantily spread; anal angle atrophied; R_{4+5} slightly curved along costal margin, ending on level of end of M_{3+4}, slightly shorter than twice R_1 (48:27); fMCu far beyond r-m; 1st A almost reaching fMCu.

Female.—Body 1.6 to 1.7 millimeters long, paler than in male; eyes bicolored as in male, broader than in male; antennæ 5-segmented; ultimate segment shorter than two preceding segments taken together, without apical setæ; second segment

FIG. 41. *Tanytarsus (Stempellina) bicoliocuius* sp. nov. *a*, Male hypopygium; *b*, female cercus; *c*, spermatheca.

shallowly constricted; maxillary palpus with last segment subequal to two preceding segments taken together. Hypopygium with many short setæ; cerci (text fig. 41, *b*) discoidal, small; ultimate sternum somewhat rectangular in outline, with a U-shaped caudal incision, a deeper V-shaped ental caudal thickening; spermathecæ (text fig. 41, *c*) almost spherical. Wings (text fig. 42, *b*) 1.3 to 1.4 millimeters long, comparatively broader, more hairy than in male, vein R_{4+5} far longer than in male, more than twice as long as R_1 (5 : 11). Foreleg ratio subequal to that of male (1.6 to 1.7); spurs of tibial combs of

one leg unequal in length; longer spur 2½, shorter twice as long as comb. Other structures of head, thorax, wings, and legs as in male.

Habitat.—Running water; Honshu, Japan.

Holotype.—Male; Kitashirakawa, Kyoto; May 15, 1930.

Allotopotype.—Female; May 15, 1930.

Paratopotypes.—Males and females; April 24, 1931, May 15, 1930, and October 30, 1935.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

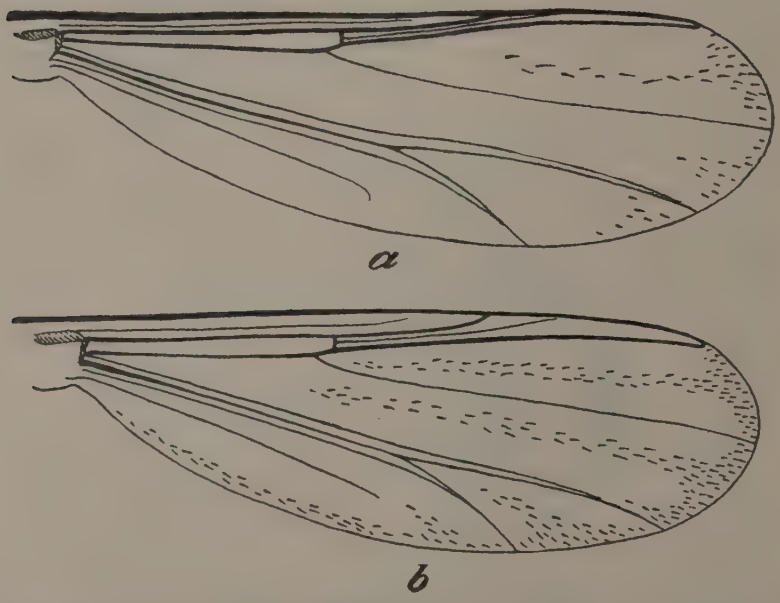


FIG. 42. *Tanytarsus* (*Stempellina*) *bicolioculus* sp. nov. *a*, Male wing; *b*, female wing.

The present species is very different from all known members of the subgenus *Stempellina* Bause in the possession of two tibial spurs on the combs of each of the posterior four legs and of the accessory lobes of the dorsal appendages of the male hypopygium, and seems to represent a transitional form to the subgenus *Tanytarsus*. Except for these conspicuous characters, this fly may be related to *T. brevis* Edwards and *T. saltuum* Goetghebuer; but the three species may be easily distinguished by the following diagnoses:

T. brevis.—Foreleg ratio 1.6, male antennal ratio 0.5, wing with macrotrichia moderately spread over, male hypopygium with anal point long and with dots, ventroproximal appendages small.

T. saltuum.—Foreleg ratio 1.2, male antennal ratio 1.3, wing with mocrotrichia thickly spread over, male hypopygium with anal point long and without dots, ventroproximal appendages hardly as long as intermediate appendages.

T. bicolioculus.—Foreleg ratio 1.6 to 1.9, male antennal ratio 0.6, wing with macrotrichia scantily spread over, male hypopygium with anal point short and with very fine pubescence, ventroproximal appendages small.

TANYTARSUS (ZAVRELIA) KIBUNENSIS sp. nov.

This fly was captured along a rapid stream in a hilly district of Kyoto.

Male.—Body small, not slender, about 2 millimeters long, very scantily haired; ground color yellow; antennæ, forelegs,

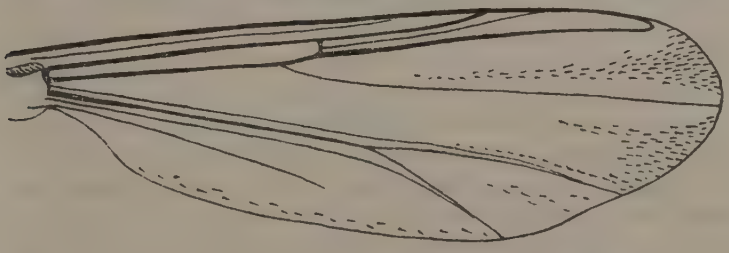


FIG. 43. *Tanytarsus (Zavrelia) kibunensis* sp. nov. Male wing.

and thoracic dorsal vittæ brownish yellow; caudal half of postscutellum brown; pleuron with a brown spot near wing base; halteres white; median scutal vittæ distinctly separated by a pale line; lateral vittæ each with a brown spot on caudal end; pedicel of the antenna white. Frontal tubercles of head obscure, but floor of frontal tubercles large and prominently projected over scapes of antennæ; eyes small, with velutinous hairs spread over entire surface, reniform, widely separate; distance between them on dorsal side 1½ times vertical length of eyes; clypeus very scantily haired; antennæ short, 11-segmented, without trace of more segments; antennal ratio about 0.28 to 0.3; distal segment very short, 1½ times as long as scape of antenna, subequal to two preceding segments taken together, clavate at tip, with two small apical setæ; maxillary palpi short, 4-segmented (11 : 23 : 30 : 52); distal segment subequal to two pre-

ceding segments taken together. Scutum shiny; supra-alar seta only one; scutellum with a pair of long setæ besides two pairs of short lateral setæ. Hypopygium (text fig. 41, *d*) yellow, short, upcurved; ultimate tergum not distinctly projected caudad, very scantily haired, with T-shaped thickening, several minute setæ on caudal part; anal point small, broad, with many minute dots; coxite with three slender setæ on thickened ventromesal margin; style small, extending dorsocaudad; dorsal appendage thinly membranous, oval, with many minute setæ; its accessory lobe curved, large; intermediate appendage distinctly curved dorsad, crowned with many strong curved setæ only on distal end; ventroproximal appendage small, with nonpubescent stem and a tuft of several long simple hairs. Legs without beards; fixed tibial spine of foreleg long, fully as long as diameter of tibia; foreleg ratio about 1.4; posterior four legs each with two conspicuous tibial combs which are distinctly separated from each other and occupy about half of circumference of tibial end; tibial combs each provided with a spur which is fully twice as long as comb itself; claws simple; empodium slender, subequal in length to claws; pulvilli wanting. Wings (text fig. 43) about 1.6 millimeters long, comparatively broad, pale brown under transmitted light, with macrotrichia only on wing tip and along anal margin; cell R_5 with a longitudinal row of macrotrichia; cell M_4 with only several macrotrichia; anal margin fringed with long hairs; anal angle atrophied; vein R_{4+5} about twice as long as R_1, ending on level of tip of M_{3+4}; fMCu far beyond base of Rs; 1st A straight, reaching base of fMCu.

Habitat.—Rapid stream; Honshu, Japan.

Holotype.—Male; Kibune, Kyoto; June 22, 1932.

Paratopotypes.—Males; June 22, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species is highly different from other members of the subgenus *Zavrelia* Kieffer in the following characters: The wing is comparatively broad, the vein R_{4+5} ends on the level of end of M_{3+4}, each of four posterior legs is provided with two combs, each comb with a distinct spur, dorsal appendage of male hypopygium with an accessory ventral lobe. The distinct characters for *Zavrelia* are shown in the structures of the compound eyes and the male antennæ. Judging from these features, the pres-

ent species seems to be of a transitional form between *Tanytarsus* (s. str.) and *Zavrelia*.

Genus YUASAIELLA novum

This genus is provided the following characters:

Male.—Head with eyes bare, small, and widely separated, with large frontal tuberclelike swellings which are not surmounted by tubercles; antennæ 13-segmented, with normal plumose hairs; maxillary palpi 5-segmented. Thorax with pronotum widely separated; scutum comparatively long, with midcephalic region (region of median vittæ) distinctly swelling dorsad, caudoscutal area flattened, a distinct hump in middle at caudal end of median vittæ. Legs without rigid combs at end of tibiæ; fore tibia without spurs; middle and hind tibiæ each with a very small comblike structure composed of very short free spinules; no spurs; pulvilli present, small; fore tibia long, at least as long as first tarsal segment. Wings milky white by reflected light, with macrotrichia on membrane; squama bare; anal area greatly reduced; venation as in *Stempellina* Bause. Hypopygium as in *Tanytarsus* in general.

Female.—Antennæ 5-segmented; pulvilli larger than in male; other characters mainly as in male.

Genotype.—*Yuasaiella kyotoensis* sp. nov.

This genus is named in honor of Dr. Hachiro Yuasa who directed our entomological laboratory during the past ten years. It is somewhat related to *Graceus* Goetghebuer, *Corynocera* Zetterstedt, and *Dolichopelma* Kieffer in the structure of the tibial end. In the first allied genus, however, all other important generic characters are quite different. In the second allied genus, the male antennæ are 12-segmented and without plumose hairs, the maxillary palpi 3-segmented, and the middle and hind femora swollen. The third genus is most closely related to the present genus, differing, however, in the absence of a middorsal hump of the thorax and a pair of the ventroproximal appendages of the male hypopygium. Another allied genus may be *Pseudochironomus* Malloch, which, however, differs greatly from the present genus in the structure of the tibial combs.

YUASAIELLA KYOTOENSIS sp. nov.

Male.—Body about 3.8 millimeters long. Head brown, with large frontal swellings; eyes bare, small, reniform, very widely separated from each other, the distance between them greater

than vertical lengths of eyes (19 : 12); frontoclypeus with about ten setæ; antenna mainly brown, with scape dark brown; ultimate segment slender, distal segments of intermediate flagellar part about twice as long as diameter; antennal ratio about 0.77; maxillary palpus 5-segmented (1 : 3 : 6 : 7.5 : 10.5). Thorax almost entirely dark brown; scutum with vittæ black, confluent; postscutellum black; pleural membranes yellow. Legs uniformly pale brown, without spurs; middle and hind tibiæ with minute spinules arranged comblike at distal end; pulvilli very small, slender; empodium as long as claws; claws simple; fore tibia longer than basitarsus; proportional lengths of segments of legs 42 : 35 : 33 : 20 : 15.5 : 10 : 6 in foreleg,

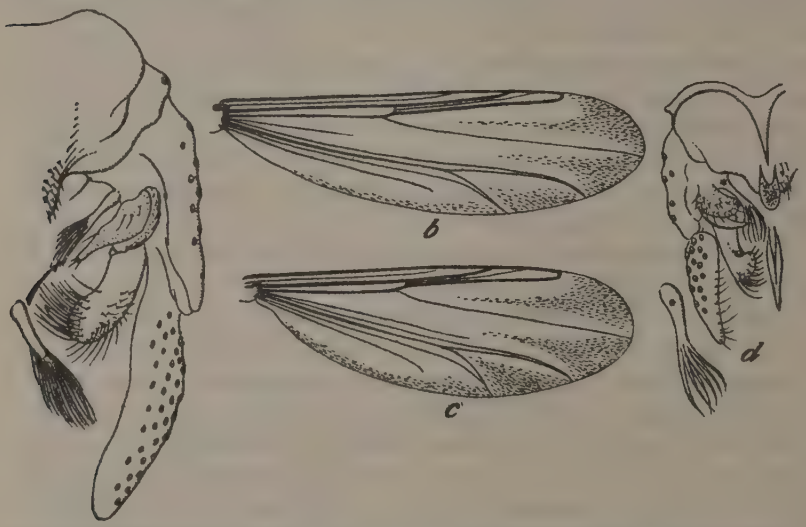


FIG. 44. *Yuasaiella kyotoensis* gen. et sp. nov. *a*, Male hypopygium; *b*, male wing; *c*, female wing; *d*, *Tanytarsus* (*Zavrelia*) *kibunensis* sp. nov. Male hypopygium.

43 : 38 : 16 : 12 : 10 : 7 : 5 in middle leg, and 53 : 44 : 24 : 16 : 13 : 9 : 5.5 in hind leg. Wing (text fig. 44, *b*) milky white, with macrotrichia comparatively sparse, found only on distal part and along anal margin; R_1 and R_{4+5} straight; R_{4+5} ending far before level of end of M_{3+4}; fMCu under middle of R_1. Halteres white. Abdomen with terga brown, sternal and pleural sides extensively yellowish brown; hypopygium (text fig. 44, *a*) pale brown, with large styles; ninth tergum slightly setigerous on caudomeson, with a slender anal point; dorsal appendage of coxite with several setæ, without accessory projection; intermediate appendage strong, with many strong setæ on apex; ventroproximal appendage small, with a simple hair on end.

Female.—Body length about 2.2 millimeters. Head pale brown; eyes oval, very widely separated, the distance between them far wider than the vertical length of eye; frontoclypeus with about fourteen setæ; antenna mainly pale brown, with scape and distal half of ultimate segment brown, 5-segmented (15 : 33 : 20 : 22 : 40); segment two distinctly constricted at middle; segments three and four fusiform; segment five not suddenly swollen basally; maxillary palpus 5-segmented (1 : 2 : 4 : 6 : 10). Thorax with four reddish brown vittæ that are distinctly separated by three lines of pale dots; shoulder parts yellowish white; caudoscutal area yellowish brown; lateral sclerites pale brown; sternal side brown; lateral membranes yellowish white. Legs pale brown, with pulvilli larger than in male; proportional lengths of segments 35 : 29 : 28 : 16 : 12 : 8 : 5 in foreleg, 35 : 32 : 14 : 8.5 : 7 : 5 : 4 in middle leg, and 42 : 37 : 18 : 12 : 10 : 6 : 4 in hind leg. Wing (text fig. 44, *c*) with R_{4+5} about twice as long as R_1. Abdomen extensively yellowish white; first tergum with a pair of large pale-brown markings; second tergum extensively pale brown, yellowish white along posterior margin; other terga each with a T-shaped yellowish brown marking; ultimate sternum pale brown; cerci pale brown, setigerous, subtriangular.

Habitat.—Hilly country; Honshu, Japan.

Holotype.—Male; Mount Hiei, Kyoto; March 17, 1932.

Allotopotype.—Female; March 17, 1932.

Paratopotype.—Female; March 17, 1932.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 20. *Tanytarsus* (*Tanytarsus*) *stagnarius* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus; *e*, spermatheca.

21. *Tanytarsus* (*Tanytarsus*) *parvicrinis* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus.

22. *Tanytarsus* (*Tanytarsus*) *kyotoensis* sp. nov. *a*, Male hypopygium; *b*, female cercus; *c*, spermatheca.

23. *Tanytarsus* (*Tanytarsus*) *kyotoensis* sp. nov. *a*, Male wing; *b*, female wing.

24. *Tanytarsus* (*Tanytarsus*) *atagoensis* sp. nov. *a*, Female wing; *b*, male hypopygium; *c*, spermatheca.

25. *Tanytarsus* (*Tanytarsus*) *atagoensis* sp. nov. Male wing.

26. *Tanytarsus* (*Tanytarsus*) *uraiensis* sp. nov. Male hypopygium.

27. *Tanytarsus* (*Tanytarsus*) *uraiensis* sp. nov. *a*, Male wing; *b*, female wing; *c*, female cercus; *d*, spermatheca; *e*, thoracic respiratory organ of pupa; *f*, dorsal side of pupal abdomen; *g*, larval antenna; *h*, larval mandible; *i*, larval hypopharynx; *j*, larval maxilla; *k*, larval mentum; *l*, larval premandible; *m*, distomesal appendage of larval epipharynx; *n*, median and midproximal appendages of larval epipharynx; *o*, distal appendage of larval labrum; *p*, laterodistal appendages of larval labrum; *q*, hooklet of anterior pseudopod of larva; *r*, plumose hair of larval abdomen.

28. *Tanytarsus* (*Tanytarsus*) *pelagicus* Tokunaga. Caudolateral spine of eighth abdominal segment of pupa.

29. *Tanytarsus* (*Rheotanytarsus*) *pentapoda* Kieffer. *a*, Male wing; *b*, male hypopygium; *c*, female wing; *d*, female antenna; *e*, female cercus; *f*, spermatheca; *g*, thoracic respiratory organ of pupa; *h*, dorsal side of abdominal segments of pupa (segment four omitted); *i*, caudal end of pupal abdomen; *j*, ventral side of abdominal segment four of pupa; *k*, plumose hair of larval abdomen; *l*, larval mentum; *m*, claws of posterior pseudopod larva; *n*, larval antenna.

30. *Tanytarsus* (*Rheotanytarsus*) *pentapoda* Kieffer. *a*, Larval labrum; *b*, larval epipharynx; *c*, larval premandible.

31. *Tanytarsus* (*Rheotanytarsus*) *æstuarius* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium.

32. *Tanytarsus* (*Rheotanytarsus*) *æstuarius* sp. nov. *a*, Female cercus; *b*, spermatheca.

33. *Tanytarsus* (*Micropsectra*) *fossarum* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium.

34. *Tanytarsus* (*Micropsectra*) *fossarum* sp. nov. *a*, Female cercus; *b*, spermatheca.

35. *Tanytarsus* (*Micropsectra*) *daisenensis* sp. nov. *a*, Female wing; *b*, male hypopygium.

36. *Tanytarsus* (*Micropsectra*) *daisenensis* sp. nov. Male wing.

37. *Tanytarsus* (*Micropsectra*) *daisenensis* sp. nov. Female cercus.

38. *Tanytarsus* (*Lundströmia*) *telmatophilus* sp. nov. *a*, Male wing; *b*, female wing; *c*, male hypopygium; *d*, female cercus; *e*, female spermatheca.

FIG. 39. *Tanytarsus* (*Lundströmia*) *tredecemarticulus* sp. nov. Male hypopygium.

40. *Tanytarsus* (*Lundströmia*) *tredecemarticulus* sp. nov. Male wing.

41. *Tanytarsus* (*Stempellina*) *bicolioculus* sp. nov. *a*, Male hypopygium; *b*, female cercus; *c*, spermatheca.

42. *Tanytarsus* (*Stempellina*) *bicolioculus* sp. nov. *a*, Male wing; *b*, female wing.

43. *Tanytarsus* (*Zavrelia*) *kibunensis* sp. nov. Male wing.

44. *Yuasaiella kyotoensis* gen. et sp. nov. *a*, Male hypopygium; *b*, male wing; *c*, female wing; *d*, *Tanytarsus* (*Zavrelia*) *kibunensis* sp. nov. Male hypopygium.

GENUS TRICHOGLOTTIS IN THE PHILIPPINE ISLANDS

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The genus *Trichoglottis* was described in 1825 by Blume [1] and by him divided into two sections. The first section contained two species, *T. retusa* and *T. lanceolaria*. The second section contained a single species, *T. rigida*, which is now considered to be a species of *Sarcanthus*.

In the Sarcanthinæ the genera are notoriously difficult to define and to delimit. No two orchidologists are able to agree on the characters to be used in the delimitation of genera, and to what genus a given species should be referred. In monographic work among the genera of the group it is necessary not only to study the species assigned to a given genus, but also to examine the species of other genera to which a plant might be referred. This makes the possibility much greater of overlooking a plant that should be placed in a genus other than the one to which it was originally assigned. For example the plant treated in this paper as *T. Loheriana* has been described as a new species under both *Acampe* and *Vandopsis*.

The number of genera in the Sarcanthinæ is probably larger than it should be. A genus that, at the time it was proposed, was apparently based on good characters may often be shown, on the evidence of additional material, to be merely a group or section of another genus.

The majority of the species treated in this review have been referred to *Trichoglottis*, at one time or another, but some of them have usually been treated as belonging to other genera.

The last treatment of any part of this genus was a short paper by Ames and Quisumbing [2] in which *T. fasciata*, *T. philippinensis*, *T. philippinensis* var. *brachiata*, and *T. Wenzelii* were placed in the genus *Stauropsis* Reichb. f. This treatment is not tenable, because *Stauropsis* must be typified by *S. pallens* which was on several occasions referred to *Phalaenopsis* [3] by

[1] Bijdr. Fl. Ned. Ind. (1825).

[2] Philip. Journ. Sci. 52 (1933) 462–468.

[3] Orch. Rev. 8 (1900) 327; 13 (1905) 226.

Rolfe, who monographed that genus. The present author believes that the plant is a *Phalaenopsis*.

The genus *Staurochilus* Ridl.[4] was based on *Trichoglottis fasciata* and should be referred to *Trichoglottis* as a synonym.

Stauropsis, at least as that name is used by most authors, has been separated from *Trichoglottis* on the following considerations:

1. The large size of the flowers; this characters seems to be of little or no value because there is an almost complete intergradation between the two extremes in the genus. The type species of *Trichoglottis*, *T. retusa*, has medium-sized flowers.

2. In conjunction with large flowers, a cruciform middle lobe of the lip has been cited as a character for generic separation. As a fundamental in separating genera lobing of the lip would seem to be a questionable character; in this particular, however, authors have not agreed, for species lacking the cruciform midlobes have been placed in *Stauropsis*. Moreover, *Trichoglottis calochila*, a small-flowered species just discovered, has a trilobulate or cruciform midlobe of the lip.

3. The footless condition of the column in the segregated genera contrasted with a column having a foot in *Trichoglottis*. While this condition may exist in some cases, the column foot in the true *Trichoglottis* is most difficult to distinguish and probably does not exist in some species. Dr. J. J. Smith[5] says "Sepalen etwas an sehr kurzem Säulenfuss herablaufend und oft etwas breiter," and again "Säule . . . . mit . . . . kurzem Fuss." The lateral sepals of the true *Trichoglottis* are occasionally adherent to the back of the spur, perhaps indicating that there is a short column foot. This condition, however, is not found in all species of the true *Trichoglottis*.

4. The presence of a spur in contrast to a saccate base of the lip. However, since there is a complete transition between the two extremes, within the genus this character seems to be of little generic significance.

Genus TRICHOGLOTTIS Blume

Trichoglottis Blume, Bijdr. (1825) 359; Bentham & Hooker, Gen. Pl. 3 (1883) 576; Pfitzer in Engler & Prantl, Nat. Pflanzenf. II 6 (1889) 218; Ridley, Mat. Fl. Malay Pen. (1907) 157; Schlechter, Die Orchideen (1914) 578; Fedde's Rep. Beih. 1 (1914) 992;

[4] Journ. Linn. Soc. 32 (1896) 351, nomen; Mat. Fl. Malay Pen. (1907) 153.

[5] Orch. Java 6 (1905) 613.

Beih. 4 (1919) 286; AMES, Orch. 5 (1915) 254; in Merrill, Enum. Philip. Fl. Pl. 1 (1925) 439 (as *Trichoglottis* Reichenbach f.).

Stauropsis of authors in part, not Reichenb. f. in Hamb. Gartenzeit. 16 (1860) 117; BENTHAM & HOOKER, Gen. Pl. 3 (1883) 572; PFITZER in Engler & Prantl, Nat. Pflanzenf. II 6 (1889) 218; RIDLEY, Mat. Fl. Malay Pen. (1907) 150 (as *Stauropsis* Benth.); AMES, Orch. 5 (1915) 224; AMES & QUISUMBING in Philip. Journ. Sci. 52 (1933) 462.

Staurochilus RIDLEY in Journ. Linn. Soc. 32 (1896) 350, nomen; Mat. Fl. Malay Pen. (1907) 153; SCHLECHTER, Die Orchideen (1914) 577; in Fedde's Rep. Beih. 4 (1919) 286; AMES in Merrill, Enum. Philip. Fl. Pl. 1 (1925) 441.

Key to the species and varieties of Trichoglottis.

*a*¹. Lip not decidedly spurred at the base; ligule not elongated or if elongated the flower small and the inflorescence a raceme.

*b*¹. Inflorescence at least as long as the leaves, usually much longer and branched; many-flowered.

*c*¹. Midlobe of the lip either distinctly trilobulate or nearly as broad as long and triangular.

*d*¹. Midlobe of the lip not triangular in outline.

*e*¹. Lateral lobules lanceolate, acute ..... 1. *T. fasciata.*

*e*². Lateral lobules semirotund, obtuse ..... 2. *T. Guibertii.*

*d*². Midlobe triangular in outline ..... 5. *T. ionosma.*

*c*². Midlobe of the lip not distinctly trilobulate.

*d*¹. Lip less than 7 mm long, midlobe only slightly longer than broad. 10. *T. intermedia.*

*d*². Lip much longer than 7 mm, midlobe much longer than broad.

*e*¹. Midlobe of the lip acute, elongated; stem abbreviated, few-leaved ..... 4. *T. luzonensis.*

*e*². Midlobe of the lip obtuse; stem elongated, many-leaved.

*f*¹. Apex of the midlobe thin, dilated, semirotund; leaves 8 to 15 cm long ..... 6. *T. mimica.*

*f*². Apex of the midlobe neither thin nor dilated; mature leaves mostly more than 15 cm long.

*g*¹. Dorsal sepal obovate, about 10 mm long. 7. *T. agusanensis.*

*g*². Dorsal sepal elliptic, about 15 mm long. 3. *T. Loheriana.*

*b*². Inflorescence much shorter than the leaves, 1- to few-flowered.

*c*¹. Midlobe of the lip without lateral lobules ..... 9. *T. Wenzelii.*

*c*². Midlobe of the lip with lateral lobules.

*d*¹. Lateral lobules of the midlobe obliquely quadrate-oblong to triangular ..... 8. *T. philippinensis.*

*d*². Lateral lobules of the midlobe acinaciform-linear. 8*a*. *T. philippinensis* var. *brachiata.*

*a*². Lip decidedly spurred at the base; ligule elongated, usually linear and flattened.

*b*¹. Midlobe of the lip with three distinct lobules, the lateral pair directed downward ..... 16. *T. calochila.*

b ². Midlobe of the lip simple.
c ¹. Lateral sepals as broad across the auriculate base as long, or nearly so ..... 14. *T. latisepala.*
c ². Lateral sepals much narrower across the auriculate base than long.
d ¹. Midlobe attached near the opening of the spur, with a callus.
e ¹. Callus erect, retuse; midlobe of lip narrowly ovate. 11. *T. mindanaensis.*
e ². Callus not erect; midlobe of lip not narrowly ovate.
f ¹. Callus near the middle of the midlobe; lateral lobes of the lip straight; ligule pubescent and expanded at the apex. 13. *T. Amesiana.*
f ². Callus near the base of the midlobe; lateral lobes of the lip decurved; ligule not expanded nor pubescent at the apex. 12. *T. bataanensis.*
d ². Midlobe attached much below the opening of the sac, lacking a callus ..... 15. *T. rosea.*

1. TRICHOGLOTTIS FASCIATA Reichenbach f.

Trichoglottis fasciata REICHENBACH f. in Gard. Chron. (1872) 699.
Staurɔpsis fasciata BENTHAM ex Jackson in Ind. Kew 2 (1885) 982; KRÄNZLIN, Xen. Orch. 3 (1894) 132, *pl. 275, figs. 1–7;* Cogn. Dict. Icon. Orch. (1904) *Stauropsis, pl. 3;* AMES & QUISUMBING, Philip. Journ. Sci. 47 (1932) 214, *pl. 2, figs. 4, 5; pls. 12, 28, 29.*
Staurochilus fasciata RIDLEY, Journ. Linn. Soc. Lond. Bot. 32 (1896) 351.
Vandopsis leytensis AMES, Orch. 5 (1915) 222.

LUZON and LEYTE; also in TROPICAL EASTERN ASIA.

2. TRICHOGLOTTIS GUIBERTII (Linden & Reichenbach f.) J. J. Sm.

Trichoglottis Guibertii (Linden & Reichenbach f.) J. J. SM., Nat. Tijds. Ned. Ind. 72 (1912) 108; AMES & QUISUMBING, Philip. Journ. Sci. 56 (1935) 464, *pl. 2, figs. 9, 10; pl. 4, figs. 26–35; pl. 10.*
Cleistoma Guibertii LINDEN & REICHENBACH f., ex Reichb. f., Bot. Zeit. 20 (1862) 375.
Vanda Guibertii LINDL. ex Reichb. f., loc. cit. syn.

LUZON. Apparently a very rare plant.

Ames and Quisumbing, in discussing the plant, do not refer to their earlier treatment of the allied species under *Stauropsis* [6] and, while they apparently were not rejecting that genus, they did not refer the present plant to it, which they might well have done were they accepting the genus as valid.

3. TRICHOGLOTTIS LOHERIANA (Kränzlin) L. O. Williams comb. nov.

Acampe Loheriana KRÄNZLIN in Fedde's Rep. 17 (1921) 386.
Vandopsis Davisii AMES & QUISUMBING, Philip. Journ. Sci. 49 (1932) 497, *pl. 2, figs. 8–11; pls. 12, 26, 27.*

[6] Philip. Journ. Sci. 52 (1933) 462–468.

LUZON. Probably only Rizal Province.

The closest ally of this species is *T. luzonensis*.

The type of *Acampe Loheriana* is probably a specimen now preserved in the Ames Herbarium, purchased from Fritz Kränzlin by Professor Ames in 1924, along with a considerable number of other specimens that had been preserved in Kränzlin's private herbarium. The specimen consists of four well-pressed flowers and a few notes. It is marked "Typus" in Kränzlin's hand.

4. TRICHOGLOTTIS LUZONENSIS Ames.

Trichoglottis luzonensis AMES, Orch. 5 (1915) 255.
Vandopsis Kupperiana KRÄNZLIN in Fedde's Rep. 17 (1921) 390.
Staurochilus luzonensis AMES in Merrill, Enum. Philip. Fl. Pl. 1 (1925) 442.

LUZON.

A distinct and apparently rare species allied to *T. Loheriana*.

5. TRICHOGLOTTIS IONOSMA (Lindl.) J. J. Sm.

Trichoglottis ionosma (Lindl.) J. J. SM., Nat. Tijds. Ned. Ind. 72 (1912) 108.
Cleisostoma ionosmum LINDL., Bot. Reg. 33 (1847) *pl. 41*.
Staurochilus ionosma SCHLECHTER, Orch. (1914) 578.

LUZON.

6. TRICHOGLOTTIS MIMICA L. O. Williams sp. nov.

Herba epiphytica cum caulibus brevibus. Folia disticha, lineari-oblonga, obtusa, retusa et paulo obliqua, coriacea. Inflorescentia pauciflora. Sepalum dorsale anguste obovatum, coriaceum. Sepala lateralia obliqua, obovata, obtusa, coriacea. Petala anguste obovata, obtusa, coriacea. Labellum trilobatum, leviter saccatum; lobi laterales erecti, prope apicem subtus breviter apiculati, coriacei; lobus medius carinatus, plusminusve oblongus, cum carina pubescenti e basi loborum lateralium fere ad apicem lobi medii et cum callo juxta lobos laterales; in sacco ligula concava papillifera, oblonga, obtusa stat.

An epiphytic herb with short stems which are about 1.5 dm long or longer, and 7 to 8 mm thick, without adventitious roots so far as known. Leaves distichous, linear-oblong, obtuse, retuse, somewhat oblique, about 2 cm apart, the blade 8 to 15 cm long, 1.5 to 2.5 cm broad, contracted and slightly conduplicate at the base, coriaceous, with veins fairly prominent at least in dry specimens. Peduncle breaking through the leaf-sheath opposite and just above the base of the leaf, many times

exceeding the leaves in length, up to about 6 dm long, often with a few short lateral branches (that is, somewhat panicled). Apparently each inflorescence bearing a relatively small number of flowers. Bracts of the inflorescence small and inconspicuous. Dorsal sepal narrowly obovate, obtuse, coriaceous, 13 to 16 mm long, 7 to 9 mm broad. Lateral sepals obliquely obovate, obtuse, coriaceous, about 14 mm long, 7 to 9 mm broad. Petals narrowly obovate, obtuse, coriaceous, 12 to 13 mm long, 5 to 7 mm broad. Lip three-lobed, somewhat saccate, about 15 mm long; lateral lobes erect, 3 to 4 mm high, short-apiculate near the middle, coriaceous, firmly joined to the column, glabrous on both surfaces; middle lobe carinate, approximately oblong, with a densely pubescent median carinate ridge extending from the bases of the lateral lobes almost to the apex of the lobe, between the bases of the lateral lobes a small callus, the lobe dilated laterally at about the same point, apex of the lobe dilated, obtuse, much thinner than the rest of the lobe, glabrous; in the saccate base of the lip a concave, papilliferous, oblong, obtuse ligule directed upward. Column short, stout, about 3 mm long, glabrous, with two falcate pubescent lateral arms at the apex.

MINDANAO, Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13977* October 1912 (Type in Herb. Ames, No. 13448) and *Elmer 13977a*.

The following note by Mr. Elmer is of interest:

> Very course tufts or masses upon the large limbs of large trees on a moist wooded ridge near the summit of Duras at 4,000 feet, near cliff; stems less than ½ inch thick, sparingly rebranched, terete, brown or gray sheath covered, very hard and rigid, crooked 1–3 feet long; roots also course, hard and extremely wirey, rather tightly attached; leaves mostly toward the ascending tips, divaricate, alternate, flat, very rigid, slightly recurved and twisted, folded at the base, pale or yellowish green on both sides, peduncles ..... persistant, terete, crooked, erect or nearly so, atropurpureous; flowers likewise rigid, ascending, nearly straminous, the spreading segments light atropurpureous, blotched on the inner side, the lip at the base deep yellow, the young flowers have a stramineous under color, when old it becomes yellow. 'Lantaoñ' in Manobo.

This species is most closely allied to *Trichoglottis ionosma* to which the specimens had been referred. It is easily distinguished from *T. ionosma* by the much smaller leaves, and by the following differences in the flower: (*a*) the midlobe of the lip of *T. ionosma* is much shorter than in the present species and (*b*) comparatively much broader; (*c*) the ligules in the

two species are different; (*d*) the lateral lobes of the species are different; (*e*) the column arms of *T. mimica* are much larger than those of *T. ionosma.*

This is the only species of this group of allied species, except the distinctive *T. agusanensis,* known from Mindanao. All of the others are known only from Luzon.

The specimen *Weber 103,* which Ames assigned dubiously to *T. luzonensis* when he described that species, possibly belongs to *T. mimica.*

A species very closely allied to *T. mimica* cannot be described at this time because the available material is not satisfactory. This plant has apparently received two herbarium names but has never been published.

7. **TRICHOGLOTTIS AGUSANENSIS Ames & Quisumbing.**

Trichoglottis agusanensis AMES & QUISUMBING in Philip. Journ. Sci. 59 (1936) 10, *pl. 1, figs. 10, 11; pl. 6, figs. 1–10.*

MINDANAO.

The only specimen I have seen is from the type plant, said to have been collected in Agusan Province. The species is quite distinctive.

8. **TRICHOGLOTTIS PHILIPPINENSIS Lindl.**

Trichoglottis philippinensis LINDL. Ann. & Mag. Nat. Hist. 15 (1845) 386; AMES, Orch. 7 (1922) 137.

Stauropsis philippinensis REICHB. f., Hamb. Gartenz. 16 (1860) 117; Xen. Orch. 2 (1862) 8; AMES & QUISUMBING, Philip. Journ. Sci. 52 (1932) 463, *pl. 2, figs. 11–13; pl. 7, figs. 19–27; pl. 16, fig. 1.*

LUZON, NEGROS, TAWITAWI, MINDANAO.

8a. **TRICHOGLOTTIS PHILIPPINENSIS var. BRACHIATA (Ames) L. O. Williams comb. nov.**

Trichoglottis brachiata AMES, Orch. 7 (1922) 136.

Stauropsis philippinensis var. *brachiata* AMES & QUISUMBING, Philip. Journ. Sci. 52 (1933) 465, *pl. 3, figs. 11–13; pl. 7, figs. 10–18; pl. 16, fig. 2;* LAYCOCK, Malay. Orch. Rev. 2 (1936) *pl. on page 99.*

Stauropsis purpurea LAYCOCK in Malay. Orch. Rev. 2 (1936) 97, nomen subnudum.

CATANDUANES, POLILLO, BILIRAN, MINDANAO.

This variety seems, on superficial examination, to be easily distinguished from the species, but when good characters are sought they prove to be most evasive. It is probable that the living plants appear more distinct than pressed specimens.

9. TRICHOGLOTTIS WENZELII Ames.

Trichoglottis Wenzelii AMES, Philip. Journ. Sci. § C 8 (1913) 440.
Trichoglottis retusa AMES, Orch. 5 (1915) 257, nom. nud. in syn., non Blume.
Stauropsis Wenzelii AMES & QUISUMBING, Philip. Journ. Sci. 52 (1933) 467, *pl. 3, figs. 14, 15; pl. 7, figs. 28–35; pl. 17.*

LUZON, LEYTE, SAMAR, BASILAN, MINDANAO.

This species is closely allied to *T. geminata* J. J. Sm. but I lack sufficient evidence to be sure of the relationship between the two.

10. TRICHOGLOTTIS INTERMEDIA L. O. Williams sp. nov.

Folia disticha, lineari-oblonga, obtusa, retusa, coriacea. Inflorescentia cum plusminusve 20 floribus. Bracteae inflorescentiae byalinae, triangulae, parvae. Sepalum dorsale anguste obovatum, obtusum, coriaceum. Sepala lateralia anguste obovata, obtusa, leviter obliqua, coriacea. Petala elliptico-oblanceolata, obtusa, coriacea. Labellum trilobatum, basi leviter saccatum; lobe laterales erecti, late lanceolati, acuti; lobus medius pubescens; in sacco ligula lanceolata, acuta stat.

Size of the plant unknown, stem probably course, 5 to 6 mm thick or more, adventitious roots probably present but their extent unknown. Leaves distichous, linear-oblong, obtuse, retuse, oblique, crowded, coriaceous, contracted and conduplicate at the base, 9 to 23 cm long, 1.5 to 3.5 cm broad. Peduncle simple or branched, up to 20 cm long, raceme bearing 20 flowers, more or less. Bracts of the inflorescence hyaline, small, about 1 mm long. Dorsal sepal narrowly obovate, obtuse, coriaceous, about 8 mm long, 3 to 4 mm broad. Lateral sepals narrowly obovate, obtuse, slightly oblique, coriaceous, about 8 mm long, 4 mm broad. Petals elliptic-oblanceolate, slightly oblique, obtuse, coriaceous, about 7 mm long, 3 mm broad. Lip three-lobed, somewhat saccate at the base, about 5 mm long; lateral lobes erect, broadly lanceolate, acute, firmly joined to the column, about 2 mm long; midlobe rounded, extremely thick, furrowed down the middle, pubescent especially near the sinuses; in the saccate base of the lip there is a lanceolate, acute ligule which is directed outward. Column short, about 1 mm long, the terminal arms nearly obsolete.

LUZON, Rizal Province, *Loher 14652* (Type in Herb. Ames, No. 44,960), *Loher s. n.*, September 1909.

Trichoglottis intermedia is the most unusual Philippine species of the genus. It appears to have no near allies. It seems

to be a species intermediate between the two groups of *Trichoglottis* found in the Philippines. It is like the small-flowered species in the size of the flower and the structure of the ligule; in other characters, short spur, type of inflorescence and leaf, it seems to be allied to the large-flowered species. The characters exhibited by this plant help to strengthen the contention that the group of species with which this paper treats should all be referred to one genus rather than to two genera.

11. TRICHOGLOTTIS MINDANAENSIS Ames.

Trichoglottis mindanaensis AMES, Philip. Journ. Sci. § C 8 (1913) 439.

LUZON, SAMAR, PANAY, MINDANAO.

A distinct and well-marked species easily distinguished from all allied species. Apparently fairly common.

12. TRICHOGLOTTIS BATAANENSIS Ames.

Trichoglottis bataanensis AMES, Orch. 1 (1905) 105, *text figure.*
Cleisostoma subviolaceum REICHENBACH f. in Bonpl. 10 (1862) 335, non *Trichoglottis subviolacea* (Llanos) Merrill.

LUZON, PALAWAN.

The history of this species, which occurs rather commonly at low elevations in Luzon, is of interest. Vidal[7] called the plants collected by Cuming, which belong here, *Trichoglottis rigida* Blume. Previous to that time the plant had been named *Cleisostoma subviolaceum* by Reichenbach f. In 1918 Merrill changed *Synptera subviolacea* Llanos to *Trichoglottis subviolacea* (Llanos) Merrill, at the same time suggesting that *T. bataanensis* Ames was referable to that name. The illustrative specimens sent out[8] are *Trichoglottis bataanensis.* I am unable to accept the name *Trichoglottis subviolacea* because there can be no certainty about its application.

13. TRICHOGLOTTIS AMESIANA L. O. Williams sp. nov.

Herba epiphytica cum caulibus usque ad 7 dm longis. Folia disticha, lineari-lanceolata, acuta vel acuminata, coriacea. Bracteae inflorescentiae parvae. Sepalum dorsale ellipticum vel anguste oblongo-ellipticum, obtusum, leviter concavum. Sepala lateralia oblonga, basi cum auricula. Petala oblanceolato-linearia, obtusa vel acuta. Labellum trilobatum, saccatum; lobi laterales erecti, lineari-oblongi; lobus medius suborbicularis, pro-

[7] Phan. Cuming. Philip. (1885) 150; Rev. Pl. Vasc. Filip. (1886) 271.
[8] Merrill: Species Blancoanae No. 733.

pe medium, cum callis duobus; saccus callo magno pubescenti et ligula subcircinata ornatus.

Stems (on specimen seen) up to 7 dm long, about 3 to 4 mm thick, terete, without adventitious roots. Leaves distichous, linear-lanceolate, acute or acuminate, mostly about 3 mm apart on the stem, 8 to 13 cm long, 7 to 12 mm broad, contracted and slightly conduplicate at the base, coriaceous. Peduncles breaking through the leaf sheaths opposite and just above the base of the leaf, very short and few-flowered, about 1 cm long. Bracts of the inflorescence small and inconspicuous. Dorsal sepal elliptic to narrowly oblong-elliptic, obtuse, slightly concave, 6 to 7 mm long, 2 to 3 mm broad. Lateral sepals semihastate or oblong with an auricle at the base, about 6 mm long, 3 mm broad. Petals oblanceolate-linear, obtuse or acutish, about 6 mm long, 2 mm broad. Lip three-lobed, strongly saccate; lateral lobes erect, linear-oblong, obtuse, about 2 mm long, firmly joined to the column near their base; middle lobe thickened, suborbicular, with a pair of small pubescent calluses near the center, about 4 mm broad; sac about 3 mm deep, at right angles to the column, with a large pubescent callus within at the base of the midlobe of the lip and a subcircinate ligule arising on the posterior wall of the sac about opposite the anterior callus, the ligule, which is about 3 mm long, curved upward and conspicuously flattened particularly at the pubescent apex. Column short, exalate, about 2.5 mm long.

LUZON, Mount Palpag, on a tree, altitude 280 meters, flowers red, yellow, and white. April 13, 1915, *Ramos & Deroy 24109* (Type in Herb. Ames, Nos. 43902 and 43915).

Trichoglottis Amesiana is very closely allied to *T. bataanensis* Ames to which it would no doubt have been referred on superficial examination. The following differences will be found upon examination of the flowers.

T. bataanensis.	*T. Amesiana.*
Midlobe of the lip longer than broad.	Midlobe of the lip broader than long.
Callus on the midlobe near attachment of claw.	Callus on the midlobe in the middle of the lobe.
Lateral lobes of the lip comparatively short, decurved.	Lateral lobes of the lip comparatively long, straight.
Ligule not pubescent nor expanded at the apex, comparatively short.	Ligule pubescent and expanded at the apex, comparatively long.
Column about 1.5 mm long.	Column about 2.5 mm long.

The name of this species is intended in some small degree to honor Prof. Oakes Ames, to whom we are largely indebted for our knowledge of the Philippine Orchidaceæ.

14. TRICHOGLOTTIS LATISEPALA Ames.

Trichoglottis latisepala AMES, Philip. Journ. Sci. § C 4 (1909) 675.

LUZON, CATANDUANES, SAMAR, PALAWAN, BANCALAN, LUMBUCAN, MINDANAO.

Widely distributed in the Islands and not uncommon.

15. TRICHOGLOTTIS ROSEA (Lindl.) Ames.

Trichoglottis rosea (Lindl.) AMES in Merrill, Enum. Philip. Fl. pl. 1 (1925) 440.
Cleisostoma rosea LINDL. in Bot. Reg. 24 (1838) miscl. 80.
Trichoglottis flexuosa ROLFE in Ames, Orch. 1 (1905) 107.
Pomatocalpa roseum J. J. SM. in Nat. Tijds. Ned.-Ind. 72 (1912) 36.

LUZON, LEYTE, BOHOL, PANAY, MINDANAO.

16. TRICHOGLOTTIS CALOCHILA L. O. Williams sp. nov.

Herba epiphytica cum caulibus usque ad 4.5 dm longis. Folia disticha, lineari-lanceolata vel lanceolata, coriacea, acuminata et apice plicata. Bracteae inflorescentiae minimae. Sepalum dorsale elliptico-oblongum, acutum, leviter concavum. Sepala lateralia late ovata, obtusa. Petala anguste oblanceolata, obtusa. Labellum trilobatum, saccatum; lobi laterales erecti, rotundati, obtusi; lobus medius trilobulatus, basi cum callis duobus; ligula in sacco stat.

Stems (on specimens seen) up to 4.5 dm long, 3 to 4 mm thick, terete or nearly so, with a few adventitious roots near the base of the plant. Leaves distichous, linear-lanceolate to lanceolate, acuminate and plicate at the apex, mostly 1.5 to 2 cm apart on the stem, 4 to 11 cm long, 6 to 12 mm broad, slightly conduplicate at the base, probably coriaceous when fresh. Peduncles breaking through the leaf sheaths opposite the base of a leaf, very short, 1- to 3-flowered, mostly less than 0.5 cm long. Bracts of the inflorescence very small and inconspicuous. Dorsal sepal elliptic-oblong, acute, slightly concave, about 8 mm long, 3.5 mm broad. Lateral sepals broadly ovate, slightly oblique, obtuse, about 6 mm long, 4 to 5 mm broad. Petals narrowly oblanceolate, obtuse, about 6 mm long, 1.5 mm broad. Lip spurred, three-lobed; the spur dorsoventrally flattened and

with two central ridges, about 3 mm long; lateral lobes erect, rounded, obtuse, about 1 mm high; middle lobe fleshy, trilobulate, the middle lobule (as seen from above) narrowly rhomboid, but with a connecting plate below so that in cross section it is T-shaped, lateral lobules subtriangular, directed downward; there are two mammillate calluses at the base of the midlobe of the lip between the bases of the lateral lobules, and a flattened ligule about 1 mm long on the posterior wall of the spur about opposite the middle lobe. Column about 3 mm long.

BOHOL, Batuan River, on rocks along stream, altitude 1,000 feet, September 2, 1923, *Ramos 796* (Type in Herbarium Ames, Nos. 44055 and 44056. LEYTE, Dagami (Panda), on trees, March 2, 1913, *Wenzel 115*, is probably this species.

Trichoglottis calochila is allied to *T. rosea*, to *T. bataanensis*, and to the other species of this alliance which superficially it resembles very much but from which it is very distinct in floral morphology. The trilobulate midlobe of the lip will serve to distinguish it from all other known species of this alliance.

It is of interest to note that the trilobulate character of the midlobe approaches the condition found in *T. fasciata* and *T. philippinensis*, which are large-flowered species with cruciform midlobes of the lip, and helps to invalidate this character as one of generic value.

OBSCURE AND LITTLE-KNOWN SPECIES

1. TRICHOGLOTTIS ATROPURPUREA Reichenbach f.

Trichoglottis atropurpurea REICHENBACH f. in Linnaea 41 (1876) 30.

Dr. Karl Keissler, curator of the Reichenbach Herbarium in Vienna, has the following to say concerning the type: "Ich bemerke, dass *Trichoglottis atropurpurea* in der hiesigen Sammlung leider fehlt." I have not been able to identify the species with a Philippine species.

2. TRICHOGLOTTIS SOLEREDERI Kränzlin.

Trichoglottis Solerederi KRÄNZLIN, in Fedde's Rep. 8 (1910) 98.

This species is said to have been collected by Loher, but in the large Loher collection I found no material referable to it. There is in the Herbarium Ames a photograph of the living plant, derived from the Kränzlin Herbarium, which has the annotation on the back "*Trichoglottis Solerederi* Kränzl. in lit." This specimen is certainly not one of the species treated herein

and allied to *T. rosea* and *T. bataanensis*. It has obliquely retuse leaves, as Kränzlin describes it, which is not the case in the above-mentioned species to which he compared it or to any of their allied species.

3. **CLEISOSTOMA BRACHYSTACHYUM Kränzlin.**

Cleisostoma brachystachyum KRÄNZLIN, Ann. Nat. Hofmus. 30 (1916) 62.

From the description and from the fact that the plant is compared to *Cleisostoma roseum* (= *Trichoglottis rosea*) it is taken to belong to *Trichoglottis*. Possibly it is *T. bataanensis*, but the description is not satisfactory and does not apply well to any species known from the Philippines.

4. **TRICHOGLOTTIS BICRURIS Kränzlin.**

Trichoglottis bicruris KRÄNZLIN in Ann. K. K. Nat. Hofmus. 30 (1916) 62.

Unknown. Doubtfully from the Philippines.

5. **TRICHOGLOTTIS SUBVIOLACEA (Llanos) Merrill.**

Trichoglottis subviolacea (Llanos) MERRILL, Sp. Blancoanæ (1918) 116.

Synptera subviolacea LLANOS, Frag. Pl. Filip. (1851) 98.

See the discussion under *T. bataanensis* Ames.

DIATOMS FROM KENON LAKE, TRANSBAIKALIA SIBERIA

By B. W. Skvortzow

Of Harbin, Manchoukuo

THREE PLATES

There appears to be no previous record of the algal vegetation of Kenon Lake in Transbaikalia, Siberia. The writer considers himself especially fortunate that so competent collector as Miss K. V. Okunzova, the science teacher of Chita High School, undertook the collection of these diatoms.

Kenon Lake belongs to the Amur river basin and lies near Chita in the Transbaikalia district of Eastern Siberia, halfway between Manchuli station on the western frontier of Manchoukuo and Lake Baikal of Siberia. The sample containing the diatoms described below was collected near the shore of the lake, from the twigs and leaves of *Potamogeton* sp., and sent to my laboratory in Harbin.

The total number of species and varieties recorded from this sample is 111. The diatom flora of Kenon Lake is characterized by significant features: (*a*) Almost all diatoms recorded were of epiphytic nature, with the following species predominating:

Fragilaria intermedia.
Synedra ulna var. *amphirynchus.*
Cocconeis placentula var. *euglypta* and var. *lineata.*
Neidium dubium and fo. *constricta.*
Navicula radiosa.
Navicula amphibola var. *subsalina.*
Cymbella parva.
Gomphonema constrictum.
Epithemia argus, with var. *ocellata* and var. *longicornis.*
Epithemia zebra var. *porcellus.*
Epithemia sorex.
Rhopalodia gibba and var. *ventricosa.*
Nitzschia sublinearis var. *sibirica.*

(*b*) Almost all diatoms recorded are fresh-water species. The 19 brackish-water forms are:

Mastogloia elliptica var. *dansei.*
Caloneis silicula and var. *truncatula.*
Caloneis bacillum.
Anomoeoneis sphaerophora and var. *polygramma.*
Navicula cryptocephala var. *intermedia* and var. *veneta.*

Navicula salinarum.
Navicula cincta.
Navicula anglica var. *subsalsa.*
Navicula amphibola var. *subsalina.*
Cymbella prostrata.
Cymbella hybrida.
Epithemia sorex.
Hantzschia virgata var. *capitellata.*
Nitzschia apiculata.
Nitzschia hybrida.
Surirella patella var. *mongolica.*

(*c*) No forms endemic in Lake Baikal have been recognized in the Kennon diatom flora. (*d*) It was interesting to see in Kenon Lake the following species: *Eucocconeis minuta* Cleve, reported from northern districts; *Achnanthes affinis* var. *bistriata* Skv., recently recorded from Nippon; *Gyrosigma attenuatum* (Kütz.) Rabh. var. *asiatica* Skv., known from Western China; *Neidium distincte-punctatum* Hust., known only from European Lakes. (*e*) Of special taxonomic interest is the discovery of the following 11 new forms:

Anomoeoneis serians var. *sibirica.*
Navicula Kenon.
Navicula longirostris var. *sibirica.*
Navicula viridula var. *argunensis.*
Navicula costulata var. *sibirica.*
Navicula amphibola var. *subsalsa.*
Pinnularia undulata var. *sibirica.*
Nitzschia angustata var. *capitata.*
Nitzschia capitellata var. *sibirica.*
Nitzschia sibirica.
Surirella patella var. *mongolica* var. nov.

MELOSIRA GRANULATA (Ehr.) Ralfs STATUS X. Plate 1, fig. 2.

Melosira granulata (Ehr.) Ralfs, Fr. Hustedt, Bacillar. (1930) 87, fig. 44.

Valve cylindrical, with robust beads. Valve height 0.015 mm; breadth, 0.009. Striæ 9, puncta 7 to 8 in 0.01 mm. Infrequent.

MELOSIRA ARENARIA Moore. Plate 1, fig. 10.

Melosira arenaria Moore, A. Schmidt, Atlas Diatom. (1893) 179, figs. 15–20.

Frustule from valve view circular, with distinct broad marginal rim and radiating striæ. Central space punctate. Diameter 0.068 to 0.076 mm. Marginal striæ 6 in 0.01 mm. Infrequent.

CYCLOTELLA COMTA (Ehr.) Kützing.

Cyclotella comta (Ehr.) Kützing, Fr. Hustedt, Bacillar. (1930) 103, fig. 69.

Valve circular, with radiate striæ and punctate central space. Diameter 0.011 mm. Striæ 12 in 0.01 mm. Rare.

CYCLOTELLA MENEGHINIANA Kützing fo. PLANA Fricke. Plate 3, fig. 4.

Cyclotella Meneghiniana Kütz. fo. *plana* Fricke, Fr. Hustedt, Bacillar. (1930) 100.

Valve circular with robust radiating costæ. Central space hyaline. Diameter 0.015 mm. Striæ 7 to 8 in 0.01 mm. Rare.

FRAGILARIA INTERMEDIA Grunow. Plate 1, figs. 13 and 31.

Fragilaria intermedia Grunow, Fr. Hustedt, Bacillar. (1930) 139, fig. 130.

Valve linear-lanceolate, parallel or gibbous in the middle. Ends subrostrate. Striæ in the middle interrupted only on one side of the valve. Length, 0.0155 to 0.025 mm; breadth, 0.0036 to 0.0051. Striæ 9 to 10 in 0.01 mm. Abundant.

FRAGILARIA CAPUCINA Desm. var. MESOLEPTA (Rabh.) Grunow. Plate 1, fig. 3.

Fragilaria capucina Desm. var. *mesolepta* (Rabh.) Grunow, Fr. Hustedt, Bacillar. (1930) 138, fig. 128.

Valve linear-lanceolate, biconstricted in the middle with interrupted striæ. Length, 0.0153 to 0.025 mm; breadth, 0.0028 to 0.0034. Striæ 15 in 0.01 mm. Infrequent.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. SUBSALINA Hustedt. Plate 1, figs. 15 and 32.

Fragilaria construens (Ehr.) Grun. var. *subsalina* Fr. Hustedt, Bacillar. (1930) 141, fig. 139.

Valve elliptic or elongate-elliptic. Central area lanceolate. Length, 0.0065 to 0.015 mm; breadth, 0.0034 to 0.004. Striæ 12 to 15 in 0.01 mm. Differs from the type in its narrower valves. Common. Reported from brackish water.

SYNEDRA ULNA (Nitzsch) Ehr. var. AMPHIRYNCHUS (Ehr.) Grunow.

Synedra ulna (Nitzsch) Ehr. var. *amphirynchus* (Ehr.) Grunow, Fr. Hustedt, Bacillar. (1930) 154, fig. 167; A. Schmidt, Atlas Diatom. (1914) pl. 302, figs. 23–26.

Valve linear-lanceolate, with attenuate and capitate ends. The middle space unstriated. Length, 0.14 mm; breadth, 0.005. Striæ 9 in 0.01 mm. Abundant.

SYNEDRA VAUCHERIAE Kützing. Plate 2, fig. 23.

Synedra Vaucheriae Kützing, A. Schmidt, Atlas Diatom. (1914) pl. 305, fig. 30.

Valve lanceolate, with unilateral interruption in the middle. Length, 0.009 to 0.015 mm; breadth, 0.003 to 0.0034. Striæ 12 to 15 in 0.01 mm. Common.

SYNEDRA RUMPENS Kütz. var. SCOTICA Grunow.

Synedra rumpens Kütz. var. *scotica* Grunow, Fr. Hustedt, Bacillar. (1930) 156, fig. 177.

Valve linear-lanceolate, in the middle suddenly undulate. Ends attenuate and subcapitate. Length, 0.037 mm; breadth, 0.0025. Striæ 15 in 0.01 mm. Infrequent.

SYNEDRA ACUS Kütz. var. RADIANS (Kütz.) Hustedt.

Synedra acus Kütz. var. *radians* (Kütz.) Fr. Hustedt, Bacillar. (1930) 155, fig. 171.

Valve narrow linear, with long attenuate ends. Striæ interrupted in the middle by a round vacant space. Length, 0.102 mm; breadth, 0.0028. Striæ 12 to 14 in 0.01 mm. Common.

EUNOTIA PRAERUPTA Ehr. var. BIDENS Grun.

Eunotia praerupta Ehr. var. *bidens* Grunow, Fr. Hustedt, Bacillar. (1930) 174, fig. 213.

Valve robust, almost straight, slightly biundulate, with broad obtuse and subcapitate ends. Length, 0.06 mm; breadth, 0.0136. Striæ 7 to 8 in 0.01 mm. Rare.

COCCONEIS PLACENTULA (Ehr.).

Cocconeis placentula (Ehr.) Fr. Hustedt, Bacillar. (1930) 189, fig. 260.

Valve elliptic, with broad-rounded ends. Upper valve with fine punctate and radiate striæ. Axial area narrow-linear. Length, 0.03 mm; breadth, 0.023. Striæ 18 in 0.01 mm. Common.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 190, fig. 261.

Differs from the type in the striæ being crossed by five broad, longitudinal, blank, undulating, bands. Length, 0.02 mm; breadth, 0.0136. Striæ 21 in 0.01 mm. Abundant.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 190, fig. 262.

Valve variable in size, elliptic. Differs from the type in the presence of 10 to 12 longitudinal bands on each side of the valve. Abundant.

COCCONEIS DIMINUTA Pantocsek. Plate 1, fig. 4.

Cocconeis diminuta Pantocsek, Fr. Hustedt, Bacillar. (1930) 190, 191, fig. 265.

Valve broad-elliptic. Striæ of the upper valve crossed by three broad longitudinal blank, undulating, bands. Length, 0.0085 to 0.011 mm; breadth, 0.005 to 0.006. Striæ of the lower valve about 30, striæ of upper valve about 18 in 0.01 mm. Rare. Reported from bottoms of large lakes.

EUCOCCONEIS MINUTA Cleve. Plate 1, figs. 23 and 24.

Achnanthidium minutum CLEVE, Diatoms of Finland (1891) 53, pl. 3, figs. 6, 7.

Valve elliptic, with broad-rounded ends. Upper valve with oblique, narrow-linear, axial, area, and subrectangular central area. Striæ mostly parallel, about 21 to 22 in 0.01 mm. Lower valve with similar axial and central area. Striæ finer. Length, 0.015 mm; breadth, 0.0076. Smaller than the type from Northern Europe. Rare.

ACHNANTHES MINUTISSIMA Kützing.

Achnanthes minutissima Kützing, FR. HUSTEDT, Bacillar. (1930) 198, fig. 274.

Valve linear-elliptic, with more distinct middle striæ. Length, 0.01 mm; breadth, 0.0025. Striæ very fine, about 30 in 0.01 mm. Infrequent.

ACHNANTHES MINUTISSIMA Kützing var. CRYPTOCEPHALA Grun.

Achnanthes minutissima Kützing var. *cryptocephala* Grun., FR. HUSTEDT, Bacillar. (1930) 198, fig. 275.

Differs from the type in its subcapitate ends. Length, 0.0136 mm; breadth, 0.002. Infrequent.

ACHNANTHES LANCEOLATA Breb. var. ROSTRATA Hustedt.

Achnanthes lanceolata Breb. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Valve elliptic-lanceolate, with undulate middle part and rostrate ends. Length, 0.01 mm; breadth, 0.0034. Striæ about 12 in 0.01 mm. Valve with a horseshoe-shaped area in the middle of one side. Infrequent.

ACHNANTHES AFFINIS Grun. var. BISTRIATA Skvortzow. Plate 2, fig. 25.

Achnanthes affinis Grun. var. *bistriata* SKVORTZOW, Diatoms from Shengtu, Szechwan, Western China, pl. 3, fig. 7.

Valve elliptic-lanceolate, with broad-rounded ends. Lower valve with rectangular central area with two more distinct shortened marginal striæ. Length, 0.0085 mm; breadth, 0.0027. Striæ 24 in 0.01 mm. Shorter than the type. Common. Known from Western China.

MASTOGLOIA ELLIPTICA Agardh var. DANSEI (Thw.) Grunow. Plate 1, fig. 14.

Mastogloia elliptica Agardh var. *dansei* (Thw.) Grunow, FR. HUSTEDT, Bacillar. (1930) 217, fig. 318.

Valve elliptic-lanceolate, with parallel margins and cuneate ends. Median line in a distinct siliceous rib, linear in the middle part and capitate cuneate at the ends. Striæ radiate and punctate. Length, 0.025 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Known from fresh and brackish water. Rare.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. Plate 3, fig. 3.

Gyrosigma acuminatum (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 222, fig. 329.

Valve sigmoid, with attenuate and obtuse-rounded ends. Axial area very narrow. Central area small elliptic. Median line sigmoid. Length 0.102 mm; breadth, 0.015. Striæ longitudinal and transversal, 18 in 0.01 mm. Rare.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. ASIATICA Skvortzow. Plate 3, figs. 11, 14, and 15.

Gyrosigma attenuatum (Kütz.) Rabh. var. *asiatica* SKVORTZOW, Diatoms from Shengtu, Szechwan, Western China, pl. 4, fig. 8.

Valve gently sigmoid and lanceolate, gradually tapering from the middle to the sigmoid obtuse ends. Length, 0.23 mm; breadth, 0.027. Transverse striæ, 10 to 11 in 0.01 mm, radiating in the middle; longitudinal striæ 7 to 8 in 0.01 mm. Rare. Reported from Western China.

CALONEIS SILICULA (Ehr.) Cleve.

Caloneis silicula (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 236, 237, fig. 362.

Valve linear-elliptic, moderately triundulate with cuneate round ends. Length, 0.093 mm; breadth, 0.016. Striæ 17 to 18 in 0.01 mm. Common. Reported from fresh and brackish water.

CALONEIS SILICULA (Ehr.) Cleve var. TRUNCATULA Grunow.

Caloneis silicula (Ehr.) Cleve var. *truncatula* Grunow, FR. HUSTEDT, Bacillar. (1930) 238, fig. 363.

Valve elliptic-lanceolate, slightly gibbous in the middle. Ends broad-rounded. Length, 0.042 mm; breadth, 0.011. Striæ 17 in 0.01 mm. Common.

CALONEIS BACILLUM (Grun.) Mereschkovski.

Caloneis bacillum (Grun.) Mereschkovski, FR. HUSTEDT, Bacillar. (1930) 236, fig. 360*a*.

Valve elliptic-lanceolate, with cuneate ends. Central area a broad rectangular fascia. Length, 0.02 mm; breadth, 0.0042. Striæ 30 in 0.01 mm. Uncommon. Reported from fresh and brackish water.

NEIDIUM DUBIUM (Ehr.) Cleve.

Neidium dubium (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 246, fig. 384*a*.

Valve elliptic-lanceolate, with rostrate ends. Length, 0.028 to 0.04 mm; breadth, 0.01 to 0.0136. Striæ 15 in 0.01 mm. Very common. Reported from fresh water.

NEIDIUM DUBIUM (Ehr.) Cleve fo. CONSTRICTA Hustedt.

Neidium dubium (Ehr.) Cleve fo. *constricta* Fr. Hustedt, Bacillar. (1930) 246, fig. 384*b*.

Differs from the type in constricted valves. Length, 0.066 mm; breadth, 0.016. Striæ 18 in 0.01 mm. Very common.

NEIDIUM IRIDIS (Ehr.) Cleve fo. VERNALIS Reichelt. Plate 1, figs. 27 and 34.

Neidium iridis (Ehr.) Cleve fo. *vernalis* Reichelt, Fr. Hustedt, Bacillar. (1930) 245, fig. 380.

Valve linear-elliptic, with broad ends. Central nodules large and comma-shaped, turned in opposite directions. Length, 0.042 to 0.047 mm; breadth, 0.012 to 0.014. Striæ 15 in 0.01 mm. Our species are akin to *Neidium mirabile* Hustedt, reported from Tibet. Infrequent.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPHIGOMPHUS (Ehr.) Van Heurck.

Neidium iridis (Ehr.) Cleve var. *amphigomphus* (Ehr.) Van Heurck, Fr. Hustedt, Bacillar. (1930) 245, fig. 382.

Valve elliptic-linear, with long and cuneate ends. Length, 0.07 mm; breadth, 0.022. Striæ about 15 in 0.01 mm. Infrequent.

NEIDIUM DISTINCTE-PUNCTATUM Hustedt. Plate 1, fig. 18; Plate 3, fig. 6.

Neidium distincte-punctatum Fr. Hustedt, Bacillar. (1930) 247, fig. 386.

Valve elliptic-lanceolate, parallel in the middle, attenuate and cuneate at the obtuse ends. Median line straight, filiform, with distinct terminal nodules and central pores slightly curved in opposite directions. Axial area linear with rectangular central area, not reaching the margins. Length, 0.052 to 0.06 mm; breadth, 0.015 to 0.017. Striæ 9 to 10, puncta 12 to 15 in 0.01 mm. Infrequent. Our specimens are larger than the European.

ANOMOEONEIS SPHAEROPHORA (Kütz.) Pfitzer. Plate 1, fig. 20.

Anomoeoneis sphaerophora (Kütz.) Pfitzer, Fr. Hustedt, Bacillar. (1930) 262, fig. 422.

Valve elliptic-lanceolate, with attenuate capitate ends. Median line filiform and straight, with curved terminal fissures. Axial area linear, central a rectangular unilateral fascia. Striæ radiate, punctate, and interrupted by a long, broad, irregular, band, from the end to the middle of the valve. Length, 0.066 to 0.085 mm; breadth, 0.017 to 0.024. Striæ 14 to 20 in 0.01 mm. Common. Reported from fresh and brackish waters.

ANOMOEONEIS SPHAEROPHORA (Kütz.) Pfitzer var. POLYGRAMMA (Ehr.) O. Müll. Plate 1, fig. 19.

Anomoeoneis sphaerophora (Kütz.) Pfitzer var. *polygramma* (Ehr.) O. Müll., Fr. Hustedt, Bacillar. (1930) 262, fig. 425.

Differs from the type in its elliptic valves. Length, 0.069 mm; breadth, 0.025. Striæ 15 in 0.01 mm. Common. Known from fresh and brackish waters.

ANOMOEONEIS SERIANS (Breb.) Cleve var. SIBIRICA var. nov. Plate 3, fig. 5.

Differt a typo striis robustis. Longis valvis 0.06 mm; latis valvis 0.012. Striis radiantes, 15 ad 16 in 0.01 mm, cum vittis longitudinali interruptis. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit K. V. Okunzova.

Valve narrow-lanceolate, tapering to the subacute ends. Axial area narrow, central suborbicular. Striæ radiate and punctate, crossed by longitudinal irregular lines. Length, 0.06 mm; breadth, 0.012. Striæ 15 to 16 in 0.01 mm. Differs from the type and var. *brachysira* (Breb.) Hust. fo. *thermalis* (Grun.) Hust. in its more robust striæ. Rare. The type is known in northern and alpine regions.

Genus NAVICULA Bory

Naviculæ orthostichæ Cleve

NAVICULA CUSPIDATA Kütz.

Navicula cuspidata Kütz., Fr. Hustedt, Bacillar. (1930) 268, fig. 433.

Valve lanceolate, with acute ends. Length, 0.136 mm; breadth, 0.028. Striæ parallel. Infrequent.

NAVICULA CUSPIDATA Kütz. var. AMBIGUA (Ehr.) Cleve.

Navicula cuspidata Kütz. var. *ambigua* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 268, fig. 434.

Differs from the type in its subrostrate ends. Length, 0.085 mm; breadth, 0.023. A craticular form was also observed.

Length, 0.056 to 0.085 mm; breadth, 0.015 to 0.023. Striæ 15 in 0.01 mm. Common.

Naviculæ bacillares Cleve

NAVICULA PUPULA Kützing. Plate 1, fig. 25.

Valve linear-elliptic with slightly gibbous margin and broad rounded ends. Central area a transverse stauros. Length, 0.03 mm; breadth, 0.0085. Striæ 18 to 20 in 0.01 mm. An intermediate form between var. *rectangulatis* and var. *capitata*.[2] Common.

NAVICULA PUPULA Kütz. var. CAPITATA Hustedt.

Navicula pupula Kütz. var. *capitata* Fr. Hustedt, Bacillar. (1930) 281, fig. 467*c*.

Valve linear-lanceolate, with capitate ends. Length, 0.022 mm; breadth, 0.0068. Common.

Naviculæ mesoleiæ Cleve

NAVICULA KENON sp. nov. Plate 2, fig. 20.

Frustulis quadratis, superne discoidalis, fronte elliptico-lanceolatis cum polis obtusis. Raphe directa. Area axillaris angusta linearis, centralis vitta transversa nuda interruptis. Striis radiantes punctatis, ad raphem cum vittis duabus atris elongatis ornata. Longis valvis 0.017 mm; latis valvis 0.006. Striis 18 in 0.01 mm. Habit. inter Potamogeton in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Frustule quadrate, with thick siliceous membrane, from upper view almost circular, from side view elliptic-lanceolate with strong convex surface. Median line filiform. Axial area narrow-linear, central area a broad rectangular stauros, not reaching to the margin. Striæ radiate throughout and distinctly punctate, interrupted by longitudinal bands. Length, 0.017 mm; breadth, 0.006. Striæ 18 in 0.01 mm. A distinct species. Rare.

Naviculæ decipientes Cleve

NAVICULA LONGIROSTRIS Hust. var. SIBIRICA var. nov. Plate 2, fig. 31.

Differt a typo striis transversis robustris. Longis valvis 0.015 mm; latis valvis 0.0034. Striis 22 to 24 in 0.01 mm. Habit. inter Potamogeton in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear-lanceolate, with parallel margins in the middle and attenuate rostrate ends. Axial and central areas very

[1] Fr. Hustedt, Bacillar. (1930) 281, figs. 467*b* and *c*.

narrow. Striæ almost parallel, coarser and slightly radiate at the ends. Length, 0.015 mm; breadth, 0.0034. Striæ 22 to 24 in 0.01 mm. Differs from the type in its more robust striæ. Rare.

NAVICULÆ LINEOLATÆ CLEVE

NAVICULA CRYPTOCEPHALA Kütz. var. INTERMEDIA Grunow. Plate 1, fig. 21.

Navicula cryptocephala Kütz. var. *intermedia* Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*b*.

Valve lanceolate, with attenuate ends. Axial area narrow-linear, central broad. Striæ radiate, convergent at the ends, longer and shorter in the middle. Length, 0.017 mm; breadth, 0.005. Striæ 14 to 15 in 0.01 mm. Infrequent. Reported from fresh and brackish water.

NAVICULA CRYPTOCEPHALA Kütz. var. VENETA (Kütz.) Grunow.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*a*.

Valve lanceolate with obtuse ends. Striæ convergent at the ends. Length, 0.0187 mm; breadth, 0.0065. Striæ 13 to 14 in 0.01 mm. Infrequent. Reported from brackish water.

NAVICULA SALINARUM Grunow.

Navicula salinarum Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 498.

Valve lanceolate, with broad margins and attenuate acute ends. Central area orbicular, with longer and shorter striæ on both sides. Length, 0.034 mm; breadth, 0.007. Striæ 12 to 15 in 0.01 mm. Rare. Reported from brackish water.

NAVICULA VIRIDULA Kütz. var. ARGUNENSIS var. nov. Plate 1, figs. 9 and 33.

Differt a typo valvis minoris, angustis et striis subtilissimis. Longis valvis 0.032 ad 0.035 mm; latis valvis 0.0051 ad 0.076. Striis 12 ad 15 in 0.01 mm. Habit. inter Potamogeton in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve narrow-lanceolate, gradually tapering from the middle to the subacute ends. Median line filiform and straight with distinct comma-shaped terminal fissures, and sometimes distinct terminal pores. Striæ radiate, striolate, slightly convergent at the ends, shorter and more distinct at the middle of the valve. Length, 0.032 to 0.035 mm; breadth, 0.0051 to 0.0076. Striæ 12 to 15 in 0.01 mm. Differs from the type in its smaller and narrower valves, coarser striæ, and in the presence of terminal pores. Common. Reported from Argun river, Western frontier of Manchoukuo.

NAVICULA COSTULATA Grun. var. SIBIRICA var. nov. Plate 2, fig. 22.

Differt a typo valvis ad medium undulatis, polis productis subcapitatis rotundatis. Longis valvis 0.017 mm; latis valvis 0.0034. Striis 18 in 0.01 mm. Habit. inter Potamogeton sp. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear-lanceolate, with undulate middle part and long subcapitate ends. Striæ robust, radiate, convergent at the ends. Lineoles of striæ not distinct. Length, 0.017 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Differs from the type in its valve being gibbous in the middle and elongate-obtuse at the ends. Our form is akin to var. *intermedia* Skv. and var. *nipponica* Skv. from Biwa Lake, Nippon.

NAVICULA CINCTA (Ehr.) Kützing. Plate 1, figs. 22 and 26.

Navicula cincta (Ehr.) Kützing, VAN HEURCK, Synopsis (1881–1885) pl. 7, figs. 13, 14.

Valve elliptic-lanceolate, with broad-rounded ends. Median line with distinct comma-shaped terminal fissures. Striæ robust, lineolate and radiate, 11 to 12 in 0.01 mm. Median striæ more distinct and more strongly marked than the others. Length, 0.015 to 0.022 mm; breadth, 0.0048 to 0.005. Common. Reported from fresh and brackish water.

NAVICULA RADIOSA Kützing.

Navicula radiosa Kützing, FR. HUSTEDT, Bacillar. (1930) 299, fig. 513.

Valve narrow-lanceolate, gradually tapering from the middle to the acute ends. Central area suborbicular. Length, 0.064 mm; breadth, 0.01. Striæ 11 in 0.01 mm. Very common.

NAVICULA REINHARDTII Grunow. Plate 2, figs. 18 and 19.

Navicula Reinhardtii Grunow, FR. HUSTEDT, Bacillar. (1930) 301, fig. 519; A. SCHMIDT, Atlas Diatom. (1911) pl. 272, figs. 1–9.

Valve elliptic-lanceolate, with short or long rounded ends. Striæ very robust, lineolate and radiate. Length, 0.028 to 0.068 mm; breadth, 0.013 to 0.018. Striæ 6 to 8 in 0.01 mm. Common.

NAVICULA ANGLICA Ralfs.

Navicula anglica Ralfs, VAN HEURCK, Synopsis (1881–1885) pl. 8, figs. 29, 30.

Valve elliptic, with rostrate ends. Striæ radiate, not punctate. Length, 0.02 mm; breadth, 0.006. Striæ 15 in 0.01 mm. Differs from the type in its coarser striæ. Common.

NAVICULA ANGLICA Ralfs var. SUBSALSA Grunow.

Navicula anglica Ralfs var. *subsalsa* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 8, fig. 31.

Differs from the type in its much less attenuate and rostrate ends. Length, 0.027 mm; breadth, 0.085. Striæ 10 to 11 in 0.01 mm, fine-lineate. Not common. Reported from slightly brackish water.

NAVICULA PLACENTULA (Ehr.) Grunow.

Navicula placentula (Ehr.) Grunow, Fr. Hustedt, Bacillar. (1930) 303, fig. 532.

Valve elliptic-lanceolate, with subrostrate ends. Median line filiform. Axial area narrow, central suborbicular. Striæ radiate throughout. Length, 0.034 mm; breadth, 0.015. Striæ 7 to 8 in 0.01 mm. Common.

NAVICULA PLACENTULA (Ehr.) Grunow fo. ROSTRATA A. Mayer.

Navicula placentula (Ehr.) Grunow fo. *rostrata* A. Mayer, Fr. Hustedt, Bacillar. (1930) 303, fig. 533.

Valve with more rostrate ends. Striæ sometimes lineolate. Length, 0.027 to 0.044 mm; breadth, 0.012 to 0.017. Striæ 7 to 11 in 0.01 mm. Common.

NAVICULA GASTRUM Ehr.

Navicula gastrum Ehr., Fr. Hustedt, Bacillar. (1930) 305, fig. 537.

Valve elliptic-lanceolate, with broad-obtuse, rostrate, ends. Median striæ longer and shorter. Length, 0.027 mm; breadth, 0.012. Striæ 10 to 11 in 0.01 mm. Common.

NAVICULA EXIGUA (Greg.) O. Müll. Plate 2, fig. 26.

Navicula exigua (Greg.) O. Müll., Van Heurck, Synopsis (1881–1885) pl. 8, fig. 32.

Valve elliptic, with narrow ends. Median striæ short and long, with broad rectangular central area. Length, 0.017 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Infrequent. Reported from fresh and brackish water.

NAVICULA OBLONGA Kütz. var. SUBPARALLELA Rattray. Plate 1, figs. 28 and 29.

Navicula oblonga Kütz. var. *subparallela* Rattray, Oestrup, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. (1909) pl. fig. 6.

Valve linear, almost with parallel margins, slightly attenuate towards the obtuse ends. Median line robust, enlarged in the middle, with comma-shaped terminal fissures. Axial area narrow, central area orbicular. Length, 0.076 to 0.0132 mm; breadth, 0.013 to 0.017. Striæ 7 to 8 in 0.01 mm. Common. The type is reported from fresh and brackish water.

NAVICULÆ PUNCTATÆ CLEVE

NAVICULA AMPHIBOLA Cleve. Plate 2, fig. 21.

Navicula amphibola Cleve, GRUNOW, Diatomeen von Franz Josefs Land (1884) 98, pl. 1, fig. 35.

Valve elliptic-lanceolate, with attenuate rostrate ends. Median lines slightly flexuous. Axial area narrow, central a stauros, widened outwards. Striæ radiate and punctate. Length, 0.034 mm; breadth, 0.014. Striæ 12 to 13 in 0.01 mm. Our specimens are closely connected with var. *manshurica* Skv., a form with rostrate ends. Rare.

NAVICULA AMPHIBOLA Cleve var. SUBSALINA var. nov. Plate 1, fig. 11.

Differt a typo valvis augustis, polis productis, striis subtilissimis. Longis valvis 0.022 ad 0.035 mm; latis valvis 0.005 ad 0.012. Striis 12 ad 18 in 0.01 mm. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve elliptic-lanceolate, gradually tapering to the acute ends. Length, 0.022 to 0.035 mm; breadth, 0.005 to 0.012. Striæ 12 to 18 in 0.01 mm. Puncta 25 to 30 in 0.01 mm. Very common. Differs from the type in its narrower valves, lanceolate ends, and coarser striæ.

Genus PINNULARIA Ehrenberg

PINNULARIÆ PARALLELISTRIATÆ

PINNULARIA UNDULATA Greg. var. SIBIRICA var. nov. Plate 2, fig. 7.

Differt a typo valvis linearis cum marginem parallelis, polis capitatis. Longis valvis 0.022 mm; latis valvis 0.005. Costis 18 in 0.01 mm. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear, with parallel margins and suddenly capitate ends. Median line filiform. Axial area narrow, central a broad fascia, reaching the margin. Striæ slightly radiate, at the ends somewhat convergent. Length, 0.022 mm; breadth, 0.005. Costæ 18 in 0.01 mm. Differs from the type in its parallel margins. The type is reported from fresh water in mountain districts. Rare.

PINNULARIÆ COMPLEXÆ

PINNULARIA VIRIDIS (Nitzsch) Ehr.

Pinnularia viridis (Nitzsch) Ehr., FR. HUSTEDT, Bacillar. (1930) 335, fig. 617*a*.

Valve elliptic-linear, with broad ends. Striæ divergent in the middle and convergent at the ends. Longitudinal band indis-

tinct. Length, 0.098 mm; breadth, 0.01. Costæ 6 in 0.01 mm. Infrequent.

PINNULARIA GENTILIS (Donk.) Cleve var. SIBIRICA Skvortzow. Plate 3, fig. 7.

Pinnularia gentilis (Donk.) Cleve var. *sibirica* SKVORTZOW, Diatoms collected by Dr. Y. Okada in Nippon I, pl. 2, fig. 2.

Valve lineate, slightly gibbous in the middle and then with parallel margins. Ends broad-rounded. Median line complex. Axial area narrow, less than $\frac{1}{3}$ of the breadth of the valve. Costæ 6 to 7 in 0.01 mm, moderately divergent and convergent at the ends. Length, 0.074 to 0.139 mm; breadth, 0.016 to 0.017. Smaller than the specimens from Nippon. Infrequent.

PINNULARIA DISTINGUENDA Cleve. Plate 3, fig. 16.

Pinnularia distinguenda CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 1.

Valve linear, indistinctly gibbous in the middle. Ends broad-rounded. Axial area less than $\frac{1}{3}$ of the valve breadth. Central area broad and distinct. Length, 0.139 mm; breadth, 0.022. Costæ 6 in 0.01 mm, divergent in the middle and convergent at the ends. Differs from the type in having a broad-rounded central area. Infrequent.

AMPHORA OVALIS Kütz. fo. GRACILIS (Ehr.) Cleve.

Amphora gracilis Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Frustule elliptic, with truncate ends. Length, 0.035 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Common.

AMPHORA OVALIS Kützing. var. PEDICULUS Kützing.

Amphora ovalis Kütz. var. *pediculus* Kützing, FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Valve elliptic, with interrupted striæ in the middle. Length, 0.015 to 0.02 mm; breadth, 0.0034 to 0.0068. Striæ 15 to 18 in 0.01 mm. Common.

AMPHORA PERPUSILLA Grunow.

Amphora perpusilla Grunow, FR. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Frustule broad-elliptic, with ventral side without striæ. Length, 0.01 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Infrequent.

AMPHORA NORMANI Rabh. Plate 2, fig. 30.

Amphora Normani Rabh., FR. HUSTEDT, Bacillar. (1930) 343, fig. 630.

Valve semielliptic, with long capitate ends. Ventral side without striæ. Length, 0.02 to 0.024 mm; breadth, 0.0034. Striæ 18 to 20 in 0.01 mm. Common.

CYMBELLA VENTRICOSA Kützing. Plate 2, fig. 24.

Cymbella ventricosa Kützing, FR. HUSTEDT, Bacillar. (1930) 369, fig. 661.

Valve semielliptic, with narrow ventral side. Length, 0.014 to 0.018 mm; breadth, 0.005 to 0.0068. Striæ, dorsal 9 to 12; ventral 10 to 15 in 0.01 mm. Infrequent.

CYMBELLA MICROCEPHALA Grunow. Plate 1, figs. 16 and 17.

Cymbella microcephala Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 8, figs. 36–39.

Valve naviculiform, lanceolate, with rostrate ends. Axial area very narrow, central small-orbicular. Striæ almost parallel. Length, 0.0153 to 0.017 mm; breadth, 0.0028 to 0.0034. Striæ 25 to 30 in 0.01 mm. Some forms have one side of the valve constricted. Differs from the type in its parallel margin. The figured specimen is a short one. Common.

CYMBELLA PROSTRATA (Berk.) Cleve. Plate 2, fig. 27.

Cymbella prostrata (Berkl.) Cleve, FR. HUSTEDT, Bacillar. (1930) 357, 358, fig. 659.

Valve semielliptic, boat-shaped, ventral side straight, dorsal arcuate and the ends obtuse. Striæ robust, distinctly lineolate. Length, 0.0187 mm; breadth, 0.0068. Striæ, dorsal 9; ventral 10, in 0.01 mm. Infrequent.

CYMBELLA HYBRIDA Grunow. Plate 2, figs. 28 and 29.

Cymbella hybrida Grunow, CLEVE, P. Synopsis Naviculoid Diatoms 1 (1894) 166, pl. 4, fig. 23; SKVORTZOW, Diatoms from Kizaki Lake, Nippon (1936) pl. 5, fig. 23.

Navicula rhynchocephala Kütz. var. *hankensis* SKVORTZOW, Diatoms from Hanka Lake (1929) 49, pl. 4, fig. 22.

Valve naviculiform, linear-lanceolate, with parallel margins and truncate ends. Striæ radiate, striolate, slightly convergent at the ends, 9 to 13 in 0.01 mm. The median striæ shortened, equal in length, or longer on one side than on the other. Length, 0.027 to 0.03 mm; breadth, 0.068 to 0.0085. Infrequent. Reported from slightly brackish water from Sweden, from Hanka Lake, Eastern Siberia, and from Kizaki Lake, Nippon.

CYMBELLA PARVULA (W. Smith) Cleve. Plate 2, figs. 13 to 17.

Cocconema parvulum Smith, A. SCHMIDT, Atlas Diatom. (1875) pl. 10, figs. 14, 15.

Valve semilanceolate, with straight or centrally slightly gibbous ventral side, and arcuate dorsal. Axial area robust, slightly oblique. Length, 0.032 to 0.049 mm; breadth, 0.0068 to 0.009. Striæ, dorsal 8½ to 10, ventral 10 to 12 in 0.01 mm. Abundant. Common in littoral zones of lakes.

CYMBELLA CISTULA (Hemp.) Grunow.

Cymbella cistula (Hemp.) Grunow, Fr. Hustedt, Bacillar. (1930) 363, fig. 676*a*.

Valve boat-shaped, with moderately gibbous ventral side and arcuate dorsal. At the ventral side of the central nodule are two puncta, ending the median striæ. Length, 0.051 mm; breadth, 0.014. Striæ 7 to 8 in 0.01 mm. Common.

CYMBELLA AFFINIS Kützing.

Cymbella affinis Kützing, Bacillar. (1930) 362, fig. 671.

Valve cymbiform, with almost straight ventral and arcuate dorsal margin. At the ventral side of the central nodule one punctum, ending the median striæ. Length, 0.045 mm; breadth, 0.013. Striæ, dorsal 8, ventral 9 in 0.01 mm. Infrequent.

CYMBELLA EHRENBERGII Kützing.

Cymbella Ehrenbergii Kützing, Fr. Hustedt, Bacillar. (1930) 356, fig. 656.

Valve rhombic-lanceolate, with broad margins and attenuate subacute ends. Striæ robust-radiate throughout. Length, 0.19 mm; breadth, 0.035. Striæ 6 in 0.01 mm. Rare.

GOMPHONEMA PARVULUM (Kütz.) Grunow.

Gomphonema parvulum (Kütz.) Grunow, Fr. Hustedt, Bacillar. (1930) 372, fig. 713*a*.

Valve lanceolate-clavate, with attenuate ends. Length, 0.0187 mm; breadth, 0.0068. Striæ 12 in 0.01 mm. Infrequent.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. LAGENULA (Kütz.? Grun.) Hustedt. Plate 1, fig. 12.

Gomphonema parvulum (Kütz.) Grun. var. *lagenula* (Kütz. Grun.) Hustedt, Van Heurck, Synopsis (1881–1885) pl. 25, fig. 7.

Valve lanceolate-clavate, with more elongate ends. Length, 0.02 mm; breadth, 0.0042. Striæ 13 in 0.01 mm. Rare.

GOMPHONEMA ACUMINATUM Ehr. fo. PUSILLA Grunow. Plate 3, fig. 10.

Gomphonema acuminatum Ehr. fo. *pusilla* Grunow, A. Schmidt, Atlas Diatom. (1902) pl. 239, figs. 19–21.

Valve biconstricted, clavate. Apex broad-capitate. Length, 0.022 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. Rare.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, Fr. Hustedt, Bacillar. (1930) 370, fig. 684.

Valve biconstricted, with apiculate apex. Length, 0.039 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Infrequent.

GOMPHONEMA LANCEOLATUM Ehr. var. INSIGNIS (Greg.) Cleve.

Gomphonema lanceolatum Ehr. var. *insignis* (Greg.) Cleve, Fr. Hustedt, Bacillar. (1930) 376, fig. 701.

Valve lanceolate-clavate, with elongate ends. The apex more robust than the basis. Length, 0.035 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. Infrequent.

GOMPHONEMA CONSTRICTUM Ehr.

Gomphonema constrictum Ehr., Fr. Hustedt, Bacillar. (1930) 377, fig. 714.

Valve clavate, with large capitate apex. Basis long attenuate. Length, 0.037 mm; breadth, 0.01. Striæ 11 in 0.01 mm. Very common.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA (Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitata* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 377, fig. 715.

Differs from the type in its more robust, broad-rounded, apex. Length, 0.027 mm; breadth, 0.011. Striæ 10 to 11 0.01 mm. Infrequent.

EPITHEMIA ARGUS Kützing. Plate 2, figs. 1, 2, and 11; Plate 3, fig. 1.

Epithemia argus Kützing, A. Schmidt, Atlas Diatom. (1904) pl. 251, figs. 2, 3, 5, 9, 12–14.

Valve semielliptic-lanceolate, with recurved subcapitate ends. Length, 0.04 to 0.042 mm; breadth, 0.007 to 0.0085. Costæ 2 to 3, striæ 12 in 0.01 mm. Abundant.

EPITHEMIA ARCUS Kütz. var. OCELLATA Kützing. Plate 2, fig. 10.

Epithemia arcus Kütz. var. *ocellata* Kützing, A. Schmidt, Atlas Diatom. (1904) pl. 251, figs. 25, 26.

Differs from the type in its short-obtuse ends. Length, 0.029 mm; breadth, 0.0085. Costæ 2 to 3, striæ 15 to 17 in 0.01 mm. Abundant.

EPITHEMIA ARGUS Kütz. var. LONGICORNIS Grunow. Plate 2, figs. 6 and 12.

Epithemia argus Kütz. var. *longicornis* Grunow, A. Schmidt, Atlas Diatom. (1904) pl. 251, fig. 15.

Valve semilanceolate, with slightly or strongly concave and arcuate dorsal margins. Ends not capitate. Length, 0.054 to

0.068 mm; breadth, 0.0085 to 0.009. Costæ 3, striæ 10 to 13 in 0.01 mm. Abundant.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. SAXONICA Kützing. Plate 2, fig. 8.

Epithemia zebra (Ehr.) Kütz. var. *saxonica* Kützing, A. SCHMIDT, Atlas Diatom. (1904) pl. 252, figs. 3–14.

Valve semielliptic, with straight ventral and arcuate dorsal side. Ends obtuse. Infrequent.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. PORCELLUS (Kütz.) Grunow. Plate 2, fig. 3.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kütz.) Grunow, A. SCHMIDT, Atlas Diatom. (1904) pl. 252, figs. 15–21.

Differs from the preceding variety by capitate ends. Length, 0.054 mm; breadth, 0.0068 to 0.007. Costæ 2, striæ 15 in 0.01 mm. Abundant.

EPITHEMIA TURGIDA (Ehr.) Kützing. Plate 2, fig. 4.

Epithemia turgida (Ehr.) Kützing, A. SCHMIDT, Atlas Diatom. (1904) pl. 250, figs. 1–6.

Valve moderately arcuate, with obtuse extremities. Median nodule reaching the middle part of the valve, then curved towards the ventral margin. Costæ radiate, alternating with double rows of puncta. Length, 0.076 mm; breadth, 0.013. Costæ 4, striæ 8 in 0.01 mm. Common. Reported from fresh and brackish water.

EPITHEMIA TURGIDA (Ehr.) Kütz. var. GRANULATA (Ehr.) Grunow. Plate 2, fig. 5.

Epithemia turgida (Ehr.) Kütz. var. *granulata* (Ehr.) Grunow, A. SCHMIDT, Atlas Diatom. (1904) pl. 250, figs. 10, 19.

Valve long, moderately arcuate, with produced subcapitate ends. Length, 0.0136 mm; breadth, 0.014. Costæ 4, striæ 9 in 0.01 mm. Common.

EPITHEMIA SOREX Kützing. Plate 2, fig. 9.

Epithemia sorex Kützing, A. SCHMIDT, Atlas Diatom. (1904) pl. 252, figs. 22–28.

Valve strongly arcuate with median nodule nearly on the margin of dorsal side. Costæ radiate. Length, 0.029 mm; breadth, 0.007. Costæ 6, striæ 12 to 14 in 0.01 mm. Abundant. Reported from fresh and brackish water.

RHOPALODIA GIBBA (Ehr.) O. Müll.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Valve linear, straight on the ventral side, arcuate on the dorsal, reflexed at the extremities. Length, 0.093 mm; breadth, 0.01. Costæ 6, striæ 12 in 0.01 mm. Abundant.

RHOPALODIA GIBBA (Ehr.) O. Müll var. VENTRICOSA (Ehr.) Grunow.

Rhopalodia gibba (Ehr.) O. Müll. var. *ventricosa* (Ehr.) Grunow, Fr. Hustedt, Bacillar. (1930) 391, fig. 741.

Shorter than the type. Length, 0.042 mm; breadth, 0.0085. Abundant.

HANTZSCHIA AMPHIOXYS (Ehr.) Grunow.

Hantzschia amphioxys (Ehr.) Grunow, Fr. Hustedt, Bacillar. (1930) 394, fig. 747.

Valve lanceolate, slightly arcuate on the dorsal and constricted on the ventral side. Apices produced and rostrate. Length, 0.083 mm; breadth, 0.009. Keel puncta 8 to 9, striæ 18 in 0.01 mm. Infrequent.

HANTZSCHIA VIRGATA (Roper) Grun. var. CAPITELLATA Hustedt. Plate 2, fig. 33.

Hantzschia virgata (Roper) Grun. var. *capitellata* Fr. Hustedt, Bacillar. (1930) 395, fig. 753.

Valve nearly straight on the ventral side, strongly arcuate on the dorsal. Keel puncta very distinct and slightly prolonged into costæ. Apices recurved and rostrate. Length, 0.48 to 0.051 mm; breadth, 0.0068 to 0.0085. Keel puncta 5 to 6; striæ 11 to 12 in 0.01 mm. Infrequent. Reported from brackish water.

Genus NITZSCHIA Hassal

Nitzschiæ tryblionellæ

NITZSCHIA APICULATA (Greg.) Grunow. Plate 3, fig. 9.

Nitzschia apiculata (Greg.) Grunow, Fr. Hustedt, Bacillar. (1930) 401, fig. 765.

Valve linear-lanceolate, constricted in the middle, with broad-apiculate ends. Striæ almost parallel, in the middle of the valve interrupted by a longitudinal hyaline band. Length, 0.052 to 0.054 mm; breadth, 0.0085. Striæ 15 to 17 in 0.01 mm. Infrequent. A brackish-water diatom.

NITZSCHIA ANGUSTATA (W. Smith) Grunow.

Nitzschia angustata (W. Smith) Grunow, Fr. Hustedt, Bacillar. (1930) 402, fig. 767.

Valve linear, with parallel margins and produced rostrate ends. Length, 0.074 mm; breadth, 0.008 to 0.009. Striæ 12 to 14 in 0.01 mm. Infrequent. Reported from fresh water.

NITZSCHIA ANGUSTATA (W. Smith) Grunow var. CAPITATA var. nov. Plate 3, fig. 8.

Differt a typo polis subcapitatis. Longis valvis 0.098 mm; latis valvis 0.0085. Striis transversis 13 in 0.01 mm. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear, with parallel margins and slightly attenuate and subcapitate ends. Length, 0.098 mm; breadth, 0.0085. Striæ 13 in 0.01 mm. Differs from the type in its capitate ends. Infrequent.

NITZSCHIÆ BILOBATÆ

NITZSCHIA HYBRIDA Grun. Plate 2, fig. 34.

Nitzschia hybrida Grun., FR. HUSTEDT, Bacillar. (1930) 406, fig. 778.

Valve slightly arcuate at the dorsal side and constricted at the ventral. Apex produced, ends reflexed. Keel puncta distinct, about 9, striæ 22 to 25 in 0.01 mm. Length, 0.068 mm; breadth, 0.0068. Rare. A brackish-water species.

NITZSCHIÆ GRUNOWIÆ

NITZSCHIA DENTICULATA Grun. Plate 1, fig. 8.

Nitzschia denticulata Grun., A. SCHMIDT, Atlas Diatom. (1921) pl. 331, figs. 35, 39.

Valve lanceolate, with keel puncta prolonged into costæ, 5 in 0.01 mm. Striæ punctate, 15 in 0.01 mm. Length, 0.018 mm; breadth, 0.0042. Common.

NITZSCHIÆ LINEARES

NITZSCHIA SUBLINEARIS Hust. var. SIBIRICA var. nov. Plate 1, fig. 30.

Differt a typo valvis marginem punctis carinalibus leniter constrictis, punctis carinalibus et striis robustis. Longis valvis 0.074 mm; latis valvis 0.0068. Punctis carinalibus 9, striis transversis 18 ad 20 in 0.01 mm. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear, with almost parallel margin. Ventral side in the middle slightly constricted. Ends produced and rostrate. Length, 0.074 mm; breadth, 0.0068. Keel puncta 9, striæ 18 to 20 in 0.01 mm. Differs from the type in its constricted middle part and the number of striæ. Fairly common.

NITZSCHIÆ LANCEOLATÆ

NITZSCHIA CAPITELLATA Hust. var. SIBIRICA var. nov. Plate 2, fig. 32.

Minor quam forma typica, polis capitatis. Longis valvis 0.017 mm; latis valvis 0.0028. Punctis carinalibus 18, striis transversis indistinctis, delicatissimis. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve lanceolate, with produced and capitate ends. Keel puncta distinct, 18 in 0.01 mm. Striæ very fine. Length, 0.017 mm; breadth, 0.0028. Differs from the type in its smaller size. Rare.

NITZSCHIA FONTICOLA Grunow.

Nitzschia fonticola Grunow, Fr. Hustedt, Bacillar. (1930) 415, fig. 800.

Valve lanceolate with short subacute ends. Keel puncta 12, striæ 25 in 0.01 mm. Length, 0.014 mm; breadth, 0.0034. Infrequent.

NITZSCHIA PALEA (Kütz.) W. Smith.

Nitzschia palea (Kütz.) W. Smith, Fr. Hustedt, Bacillar. (1930) 416, fig. 801.

Valve linear or linear-lanceolate, with attenuate and rostrate ends. Length, 0.03 to 0.037 mm; breadth, 0.0029 to 0.005. Keel puncta 10 to 12, striæ about 35 in 0.01 mm. Infrequent.

NITZSCHIA PALEA (Kütz.) W. Smith var. TENUIROSTRIS Grunow.

Nitzschia palea (Kütz.) W. Smith var. *tenuirostris* Grunow, Fr. Hustedt, Bacillar. (1930) 416; Skvortzow, Diatomees recoltees par le Pere E. Licent dans le nord de la Mandjourie (1935) 43, pl. 9, fig. 40.

Valve elongate, slightly constricted in the middle. Length, 0.056 mm; breadth, 0.0036. Keel puncta 11 to 12 in 0.01 mm. Striæ transversal, very fine and indistinct. Not Common.

NITZSCHIA COMMUNIS Rabh.

Nitzschia communis Rabh., Van Heurck, Synopsis (1881–1885) pl. 119, fig. 32.

Valve elliptic-lanceolate, with broad-obtuse ends. Length, 0.022 mm; breadth, 0.003. Keel puncta 11 in 0.01 mm. Striæ very fine. Differs from the type in its narrower valves. Infrequent.

NITZSCHIA SIBIRICA sp. nov. Plate 1, figs. 6 and 7.

Valvis linearis-lanceolatis, polis productis obtusis. Punctis carinalibus minimus, 9 in 0.01 mm. Striis 15 in 0.01 mm. Longis valvis 0.0068 ad 0.01 mm; latis valvis 0.0017 ad 0.002. Egrege *Nitzschia frustulum* (Kütz.) Grun. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve linear-lanceolate, with slightly produced-obtuse ends. Keel puncta distinct and robust, about 9, striæ 15 in 0.01 mm. Length, 0.0068 to 0.01 mm; breadth, 0.0017 to 0.002. A distinct minute species akin to *Nitzschia frustulum* (Kütz.) Grun. Infrequent.

CYMATOPLEURA SOLEA (Breb.) W. Smith. Plate 3, fig. 2.

Cymatopleura solea (Breb.) W. Smith, A. SCHMIDT, Atlas Diatom. (1911) pl. 276, figs. 1, 2.

Valve elongate, constricted on both sides. Ends cuneate and rounded. Length, 0.132 mm; breadth, in the middle 0.02, at the broader part of the ends 0.032. Costæ 7 in 0.01 mm. Infrequent.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith var. NOBILIS (Hantzsch) Hustedt. Plate 3, fig. 13.

Cymatopleura elliptica (Breb.) W. Smith var. *nobilis* (Hantzsch), FR. HUSTEDT, Bacillar. (1930) 427, fig. 828.

Valve rhombic-elliptic, with produced and rounded ends. Length, 0.129 mm; breadth, 0.062. Costæ 3 in 0.01 mm. Common.

SURIRELLA PATELLA Ehr. var. MONGOLICA var. nov. Plate 3, fig. 12.

Differt a typo valvis ovalis cum polis vastis rotundatis. Costis robustis, 4 in 0.01 mm, striis transversalis subradiantes ad area axillaris percurrentes, 12 in 0.01 mm. Area axillaris lineata longitudinalis, nuda. Longis valvis 0.028 mm; latis valvis 0.017. Habit. in lacum Kenon, Transbaikalia, Siberia. Legit. K. V. Okunzova.

Valve broad-ovate, with one end broader than the other. Costæ robust, not reaching the axial area. Axial area linear and hyaline. Length, 0.028 mm; breadth, 0.017. Costæ 4, striæ 12 in 0.01 mm. Rare. It seems to me that different forms of *Surirella ovata* Breb., reported by me in 1929 from Dalai-nor Lake, eastern Mongolia belongs to several species. In that publication pl. 1, fig. 7 is *Surirella ovalis* Breb., pl. 1, fig. 14 is *Surirella peisonis* Pant., and pl. 1, fig. 6 belongs to *Surirella patella* Ehr. var. *mongolica* var. nov.

SURIRELLA CAPRONII Breb.

Surirella Capronii Breb., FR. HUSTEDT, Bacillar. (1930) 440, fig. 857.

Valve narrow, ovate, with one end much broader than the other, with distinct spines near each end. Costæ reaching the median area. Filaments only.

CAMPYLODISCUS NORICUS Ehr. var. GENUINA Grunow. Plate 1, fig. 1.

Campylodiscus noricus Ehr. var. *genuina* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 77, fig. 6.

Valve circular, strongly curved. Outer rim distinct, costæ with two rows of beads. Central area punctate. No striæ on the surface of the valve. Diameter 0.127 mm. Costæ $1\frac{1}{2}$ to 2 in 0.01 mm. Rare. Reported from bottom of large lakes.

CAMPYLODISCUS NORICUS Ehr. var. HIBERNICUS (Ehr.) Grunow. Plate 1, fig. 5.

Campylodiscus noricus Ehr. var. *hibernicus* (Ehr.) Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 77, fig. 3.

Valve triangular, strongly curved, distinctly striated. Outer rim distinct. Costæ with one row of beads. Central area not punctate. Differs from the type in its hyaline central area. The type has a punctate central part of the valve. Diameter 0.102 mm. Costæ 2 in 0.01 mm. Rare.

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SKVORTZOW, B. Diatomees recoltees par le Pere E. Licent dans le nord de la Mandjourie. Tientsin (1935).

SKVORTZOW, B. Diatoms from Kizaki Lake, Nippon. Philip. Journ. Sci. 61 (1936) 9.

SKVORTZOW, B. Diatoms from Shengtu, Szechwan, Western China. Unpublished manuscript.

SKVORTZOW, B. Diatoms, collected by Dr. Y. Okada in Nippon. I. Unpublished manuscript.

SKVORTZOW, B., and C. I. MEYER. A contribution to the Diatoms of Baikal Lake. Harbin (1928).

SKVORTZOW, B. Bottom diatoms from "Olhon-Gate" of Baikal Lake, Siberia. Philip. Journ. Sci. 62 (1937) 293.

VAN HEURCK, H. Synopsis des Diatomees belgiques. Anvers (1881–1885).

ILLUSTRATIONS

Plate 1

Fig. 1. *Campylodiscus noricus* Ehr. var. *genuina* Grun.
2. *Melosira granulata* (Ehr.) Ralfs *status X.*
3. *Fragilaria capucina* Desm. var. *mesolepta* (Rabh.) Grun.
4. *Cocconeis diminuta* Pant.
5. *Campylodiscus noricus* Ehr. var. *hibernicus* (Ehr.) Grun.
Figs. 6 and 7. *Nitzschia sibirica* sp. nov.
Fig. 8. *Nitzschia denticulata* Grun.
9. *Navicula viridula* Kütz. var. *argunensis* var. nov.
10. *Melosira arenaria* Moore.
11. *Navicula amphibola* Cleve var. *subsalina* var. nov.
12. *Gomphonema parvulum* (Kütz.) Grun. var. *lagenula* (Kütz.? Grun.) Hust.
13. *Fragilaria intermedia* Grun.
14. *Mastogloia elliptica* Agardh var. *dansei* (Thw.) Grun.
15. *Fragilaria construens* (Ehr.) Grun. var. *subsalina* Hust.
Figs. 16 and 17. *Cymbella microcephala* Grun.
Fig. 18. *Neidium distincte-punctatum* Hust.
19. *Anomoeoneis sphaerophora* (Kütz.) Pfitzer var. *polygramma* (Ehr.) O. Müll.
20. *Anomoeoneis sphaerophora* (Kütz.) Pfitzer.
21. *Navicula cryptocephala* Kütz. var. *intermedia* Grun.
22. *Navicula cincta* (Ehr.) Kütz.
Figs. 23 and 24. *Eucocconeis minuta* Cleve.
Fig. 25. *Navicula pupula* Kütz.
26. *Navicula cincta* (Ehr.) Kütz.
27. *Neidium iridis* (Ehr.) Cleve fo. *vernalis* Reichelt.
Figs. 28 and 29. *Navicula oblonga* Kütz. var. *subparallela* Rattray.
Fig. 30. *Nitzschia sublinearis* Hust. var. *sibirica* var. nov.
31. *Fragilaria intermedia* Grun.
32. *Fragilaria construens* (Ehr.) Grun. var. *subsalina* Hust.
33. *Navicula viridula* Kütz. var. *argunensis* var. nov.
34. *Neidium iridis* (Ehr.) Cleve fo. *vernalis* Reichelt.

Plate 2

Figs. 1 and 2. *Epithemia argus* Kütz.
Fig. 3. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun.
4. *Epithemia turgida* (Ehr.) Kütz.
5. *Epithemia turgida* (Ehr.) Kütz. var. *granulata* (Ehr.) Grun.
6. *Epithemia argus* Kütz. var. *longicornis* Grun. Anomali.
7. *Pinnularia undulata* Greg. var. *sibirica* var. nov.
8. *Epithemia zebra* (Ehr.) Kütz. var. *saxonica* Kütz.
9. *Epithemia sorex* Kütz.

FIG. 10. *Epithemia arcus* Kütz. var. *ocellata* Kütz.
11. *Epithemia argus* Kütz.
12. *Epithemia argus* Kütz. var. *longicornis* Grun.
FIGS. 13 to 17. *Cymbella parvula* (W. Smith) Cleve.
FIGS. 18 and 19. *Navicula Reinhardtii* Grun.
FIG. 20. *Navicula Kenon* sp. nov.
21. *Navicula amphibola* Cleve.
22. *Navicula costulata* Grun. var. *sibirica* var. nov.
23. *Synedra Vaucheriae* Kütz.
24. *Cymbella ventricosa* Kütz.
25. *Achnanthes affinis* Grun. var. *bistriata* Skv.
26. *Navicula exigua* (Greg.) O. Müll.?
27. *Cymbella prostrata* (Berk.) Cleve.
FIGS. 28 and 29. *Cymbella hybrida* Grun.
FIG. 30. *Amphora Normani* Rabh.
31. *Navicula longirostris* Hust. var. *sibirica* var. nov.
32. *Nitzschia capitellata* Hust. var. *sibirica* var. nov.
33. *Hantzschia virgata* (Roper) Grun. var. *capitellata* Hust.
34. *Nitzschia hybrida* Grun.

PLATE 3

FIG. 1. *Epithemia argus* Kütz.
2. *Cymatopleura solea* (Breb.) W. Smith.
3. *Gyrosigma acuminatum* (Kütz.) Rabh.
4. *Cyclotella Meneghiniana* Kütz. fo. *plana* Fricke.
5. *Anomoeoneis serians* (Breb.) Cleve var. *sibirica* var. nov.
6. *Neidium distincte-punctatum* Hust.
7. *Pinnularia gentilis* (Donk.) Cleve var. *sibirica* Skv.
8. *Nitzschia angustata* (W. Smith) Grun. var. *capitata* var. nov.
9. *Nitzschia apiculata* (Greg.) Grun.
10. *Gomphonema acuminatum* Ehr. fo. *pusilla* Grun.
11. *Gyrosigma attenuatum* (Kütz.) Rabh. var. *asiatica* Skv.
12. *Surirella patella* Ehr. var. *mongolica* var. nov.
13. *Cymatopleura elliptica* (Breb.) W. Smith var. *nobilis* (Hantz.) Hust.
FIGS. 14 and 15. *Gyrosigma attenuatum* (Kütz.) Rabh. var. *asiatica* Skv.
FIG. 16. *Pinnularia distinguenda* Cleve.

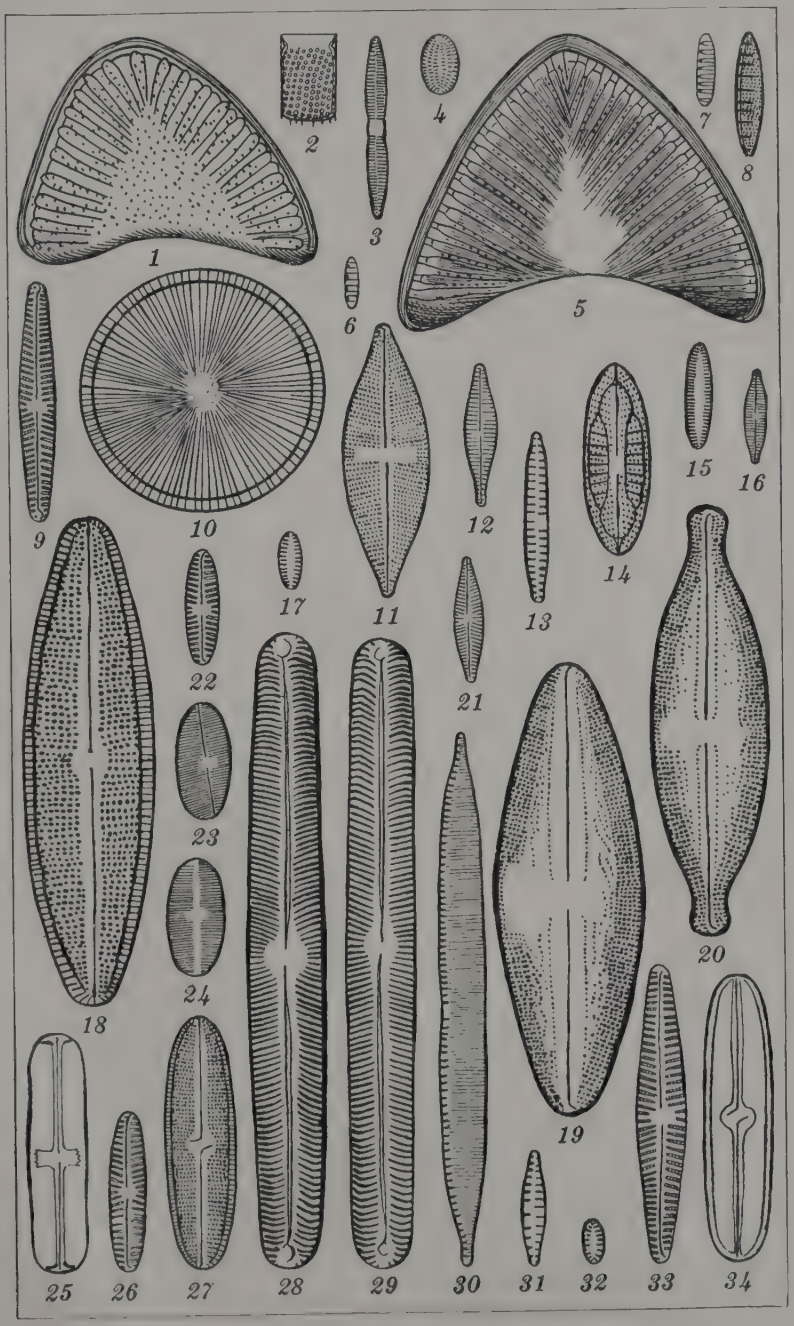
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PLATE 1.

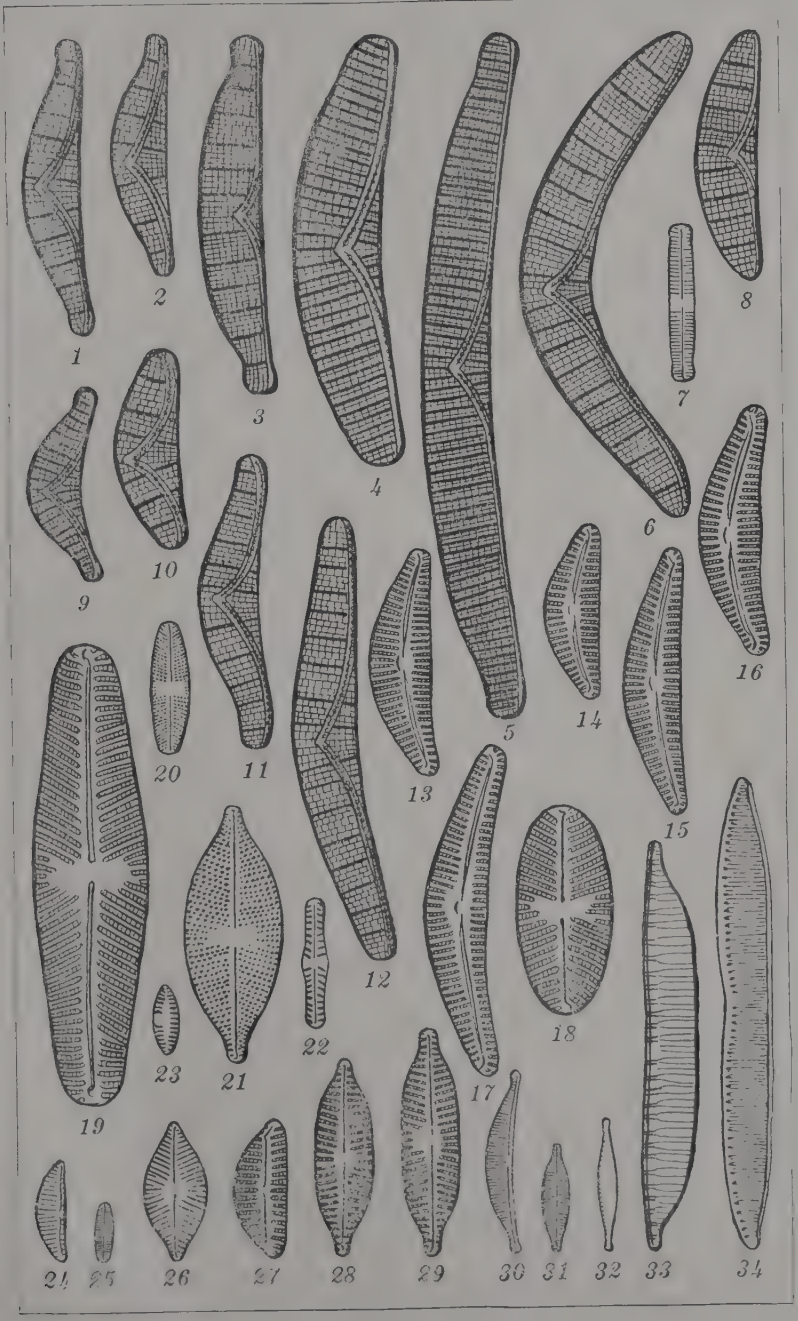
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PLATE 2.

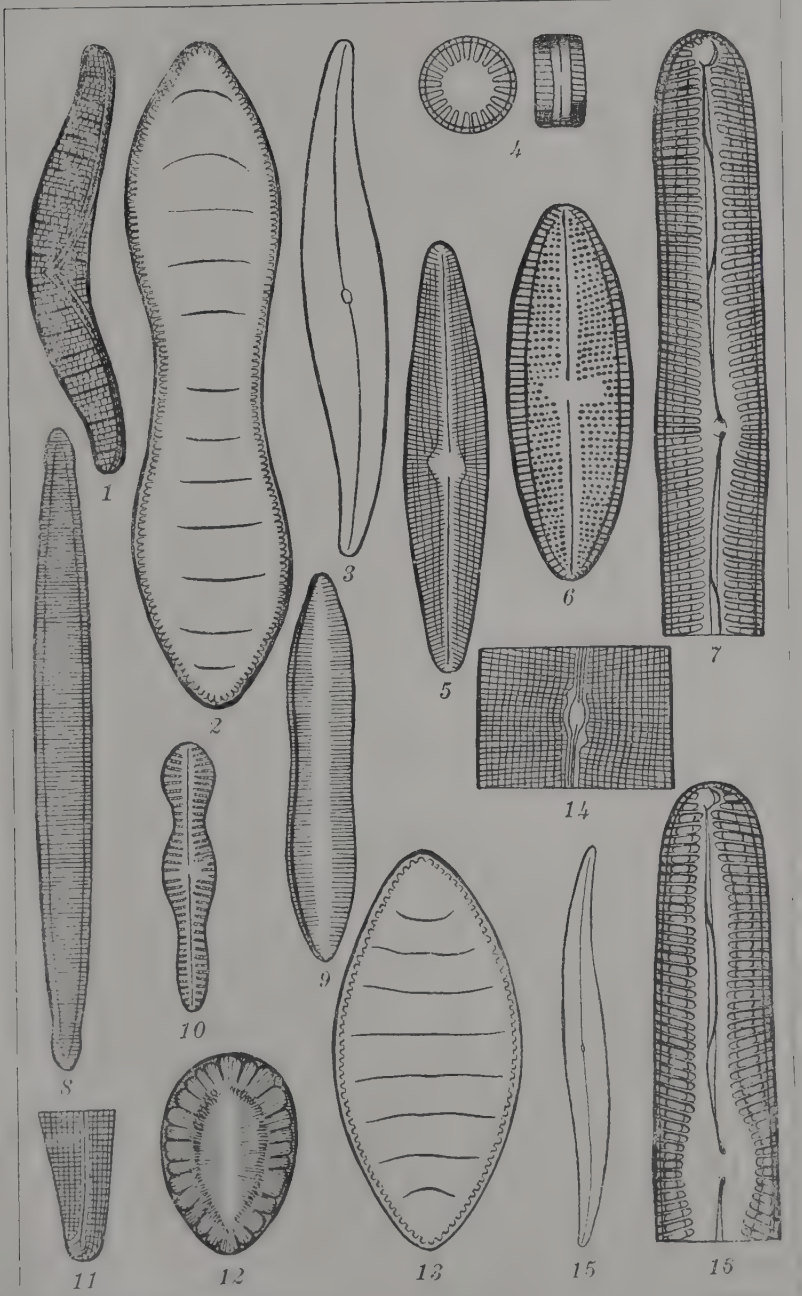

PLATE 3.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

ABBEY, Mrs. ARTHUR. Practical goat-keeping. London, Cassell & Co., Ltd., 1936. 114 pp., pls. Price, 1s 6d.

American College of Chest Physicians. Pneumothorax directory. 1937 ed. El Paso, Texas, American College of Physicians. 34 pp. Price, $1.

American Society for Testing Materials. Standards on rubber products. Prepared by Committee D–11 on rubber products. Methods of testing specifications. The Society, 1937. 238 pp., illus. Price, $1.25.

Ceramic data book. Featuring equipment and materials catalogs, also buyer's directory, including a review of developments in the industry as recorded in the literature; handbook section; practical tests, and methods of making ceramic calculations. 1938 (10th) ed. Chicago, Industrial publications, Inc., 1937. 292 pp. Price, $5.

FISCHER, LOUIS. The baby and growing child; feeding and health care for physicians, mothers, and nurses. New York, Funk and Wagnalls Company, 1936. 260 pp., illus. Price, $1.50.

FISHER, V. E. Auto-correctivism; the psychology of nervousness. Caldwell, Idaho, The Caxton Printers, ltd., 1937. 337 pp. Price, $3.50.

FRIEDMANN, E. Sterols and related compounds. A series of three lectures delivered at the Institute of Biochemistry, Cambridge. With a foreword by Prof. Sir. Frederick Gowland Hopkins. Cambridge, W. Heffer & sons, ltd., 1937. 100 pp. Price, 7s 6d.

Great Barrier Reef Expedition, 1928–29. Scientific Reports, v. 1–4, 40 nos. London, British Museum (Natural History), 1930–34. Price, ₱100.

Imperial Institute. Mineral Resources Department. The Mineral position of the British Empire. London, Imperial Institute, 1937. 166 pp. Price, 4s.

KIRK, ESBEN. Amino acid and ammonia metabolism in liver diseases. Copenhagen, Levin & Munksgaard, Publishers, 1936. 147 pp.

SAUNDERS, E. R. Floral morphology; a new outlook with special reference to the interpretation of the gynæceum. v. 1. Cambridge, W. Heffer & sons, ltd., 1937. 132 pp. Price, 3s 6d.

STEVENS, J. THOMPSON. The control of goiter; the thyroid in health and disease. New York, A. S. Barnes and Company, 1937. 211 pp., illus. Price, $2.50.

TALBOT, G. A monograph of the Pierine Genus Delias. London, British Museum, 1937. 656 pp., pls., illus. Price, ₱12.50.

REVIEWS

Amino Acid and Ammonia Metabolism in Liver Diseases. By Esben Kirk. Copenhagen, Levin & Munksgaard, Publishers, 1936. 147 pp., tables. Price, 10 kr.

This monograph of 147 pages consists of observations on the amino acid and ammonia content of blood and urine of normal persons and patients suffering from mild liver cirrhosis, obstructive jaundice, and acute hepatitis. The dissertation is characteristic of most European scientific reports, covering extensive reviews of literature, meticulous details of technique, and a thorough discussion of results. Case histories are appended.

Most significant in the whole dissertation therefore is the finding that the blood ammonia in liver cirrhosis is higher than normal. The author however calls attention to the fact that the rise in blood ammonia is not proportional to the severity of the disease. Extremely mild cases have shown higher blood ammonia than moderately severe ones. The possibility is raised that the high blood ammonia may be due not to impairment of the function of the liver per se, but to the shutting off of blood from the liver direct to the inferior vena cava, because of the dilatation of collateral blood vessels commonly known to occur in cirrhosis of the liver. In other words, the lack of conversion of ammonia to urea may be due also to the deviation of blood, so that not all could pass through the liver. Since such a contingency may occur in tumors pressing on the portal vein even with the liver cells normal, a doubt is raised as to the validity of ammonia tolerance as a test of liver function.—N. C.

Atlas of Congenital Cardiac Disease. By Maude E. Abbott. New York. The American Heart Association, 1936. 62 pp., 25 plates. Price, ₱11.

Doctor Abbott has produced a book that is very interesting and instructive to physicians and medical students. The cases studied and explained are clearly pictured in plates and illustrative diagrams. The complex and ingenious congenital defects of the heart originating in embryonic development of the organ is clearly represented in a comparative demonstration with Spitzer's theory of incomplete tortion of the embryonic heart as the causation of cardiac defects.

The clinical classification of congenital cardiac diseases is divided into three groups: Acyanotic, cyanose tardive, and cyanotic. This classification of symptoms and circulatory disturbances based on anatomical lesions of the heart make this atlas a living and dynamic representation of the individual cases, and is very valuable especally to internists and pathologists.

It is interesting to note the following rare and complicated congenital cardiac defects: "Morbus coerleus" or congenital cyanosis, the Eisenmenger complex, the tetralogy of Fallot, the persistent truncus arteriosus, and the congenital rhabdomyoma.

The book has a good bibliography on congenital cardiac diseases.—J. Z. S. C.

Crystallization and Pan-Boiling. By A. L. C. Mathot. Calcutta, Thacker, Spink & Co., Ltd., 1935. 56 pp., diagrams. Price, ₱2.50.

What is known about the mechanics and chemistry of sugar crystallization is briefly explained in this book. Evidently the technic of obtaining a good quality of sugar with regular crystals is either a matter of guess or the product of long experience in the industry. In order to devise a control in the production of an acceptable product, the author set up various experiments to follow the progress of boiling and the stages through which the sugar juice has to go before crystallization begins. As a result, grain is affected by various factors, such as the concentration of the mother liquor before it is conveyed to the crystallizer, agitation during crystallization, purity of the juice, and structure of the apparatus.

Several crystallizers are mentioned, and their construction and advantages are described and explained. The author feels that the book is far from complete without some information about the final molasses. His ideas in this connection are condensed in the form of theoretical considerations.

Among the control apparatus used, the pan-refractometer is especially considered. A sketch is given, showing a simple arrangement and also a short description of the different parts.

In general, the book is a good guide to sugar technologists who are more inclined to the use of pan boiling in the sugar industry. Although the author avoided the use of many technical terms, he incorporated some foreign expressions which made reading of the book difficult. To make it easier reading, particularly to laymen, he should have explained and defined the foreign terms such as pied-de-cuite, masse-cuite, brix, and others.—M. P. R.

Culture Methods for Invertebrate Animals; a Compendium Prepared Cooperatively by American Zoölogists Under the Direction of a Committee from Section F of the American Association for the Advancement of Science. Edited by Paul S. Galtsoff, Frank E. Lutz, Paul S. Welch, and James G. Needham, Chairman. Ithaca, New York, Comstock Publishing Co., Inc., 1937. 590 pp., illus. Price, $4.

"This book has been prepared as an aid to studies that require living animals in continuous supply." It is a compendium of articles prepared by one hundred and eighty-six specialists and edited by a committee of the American Association for the Advancement of Science. The book begins with two installments on the general methods of collecting, maintaining, and rearing terrestrial and aquatic animals. The remainder is taken up with articles arranged systematically by classes under their respective phyla, beginning with the Protozoa and ending with the Chordata. The articles bear the names of their contributors. This volume is, therefore, a valuable record of the practices that the authors have found successful in their cultural management of invertebrate animals. The committee hopes that "this compilation on culture methods may stimulate interest in maintaining living animals in biological laboratories and may lead to further development of the proper technique.

This work will be useful for the teacher of biology in colleges and high schools and for the researcher in the fields of genetics, parasitology, experimental zoölogy, entomology, and microbiology. The reviewer, however, is surprised to find one group of insects, namely, the Siphonaptera, or fleas, not dealt with. Because of the importance of the group in public health work, it is hoped that it will find a place in a future edition of the book.—M. T.

Globe Trotting With a Surgeon. By Alexander H. Peacock. With photographs by the author. Seattle, The Press of Lowman & Hantord Co., c1936. 276 pp.

To lovers of travel and of life, history, and art, reading short passages here and there in reviewing such a book as "Globe Trotting With a Surgeon" is not sufficient. Few are the men who have seen and appreciated as has the author of this book, whose rare ability enabled him to make others unfold the histories of by-gone dynasties, appreciate oriental arts and accomplishments, evaluate the pomp and grandeur of nature, and ably interpret the works of the great masters of art and religion.

In his preface the author cites many ways of circumnavigating the world, but he apparently forgot that reading such a book as his is more useful than circumnavigating the globe without the ability to appreciate and to interpret. This book gives a vivid picture of life on a boat, the making of acquaintances with people of different callings and nationalities. The points of

interest picturesquely described are the Garden of Eden of Honolulu, artistic Japan, the ancient splendor and modern poverty in China, a glimpse of Manila, Singapore, Ceylon, Bombay, and other ports. The chapter on Rome with its treasures is the most interesting and instructive of all. The author shows special proficiency in noting differences of customs, dress, and idiosyncracies of nations, but he is just as keen in seeing similarities in the emotions and temperament of these peoples.—I. F.

Health Questions Answered. By W. W. Bauer. New York, The Bobbs-Merrill Company, c1937. 368 pp. Price, $2.

Valuable fundamental knowledge on hygiene, control of contagious diseases, anatomy, physiology, and various health practices is contained in this book for the layman. According to the author's introduction, "This book is a compilation of questions selected from among more than ten thousand letters, asking almost fifteen thousand questions" addressed to the American Medical Association. From it the reader derives an intelligent attitude toward health and disease. Misrepresentations of quacks, impostors, and faddists are exposed, and patients are guided in the selection of a physician. The content is well divided into 13 chapters, and a subject index makes the book convenient for ready reference. This book will be a valuable asset to any home library.—I. F.

L'Infection Bacillaire et la Tuberculose Chez L'Homme et Chez Les Animaux. Etude Bioloque et Experimentale. Vaccination Preventive. Par A. Calmette. 4-ieme ed. entierement revue et complatèe par A. Boquet et L. Negre. Paris, Masson et Cie, 1936. 1024 pp., plates, illus. Price, 175 fr.

The 4th French edition of the book of Dr. Calmette, with the title of "L'Infection Bacillaire et la Tuberculose," published posthumously by his pupils, A. Boquet and L. Negre, is one of the best books written on the general subject of tuberculosis. It summarizes not only the most important pieces of research all over the world in regard to the bacteriology, etiology, pathogenicity, prevention, and immunization of tuberculosis, but also the personal ideas and observations of the author and his collaborators, based on extensive experimental work. The volume is divided into 4 parts, each composed of several chapters, with a historical introduction on tuberculous virus.

In the first part, the bacteriology of tuberculosis in its various aspects, including the filtrable forms, the different

paratubercle acid-fast bacilli, and the various preparations of tuberculins, is thoroughly discussed. It also treats of the various forms of tuberculous infection and the anatomopathological lesions in children, adults, and in the aged. The different channels of tuberculous infection, and the character and localization of lesions in the serous membranes and different organs of the human body, are also described. A special chapter is dedicated to the blood culture and bacillæmia of tuberculosis, and to such other important topics as heredity and transmission of the disease through the genital tract.

The second part deals with the various problems of experimental tuberculosis in various animals, the character of the anatomic lesions, and the rôle played by bovine tubercle bacilli in human infection. The natural tuberculosis in various other mammifera and birds are also considered.

The third part is dedicated to the various antibodies and defenses of the body, the channels of elimination of tubercle bacilli, and the various biological and laboratory reactions used in the diagnosis of tuberculosis. The physiological action and the mechanism of the tuberculin reactions are also fully discussed.

The fourth part comprises natural immunity and the various methods of immunization including the active, the passive, and other biological methods, especially antigenotherapy and chemotherapy.

The last chapters are dedicated to the prevention of tuberculosis by means of the B. C. G. vaccine. The experiences of the author and his collaborators in human beings and vaccinated animals are clearly exposed. The cultural methods of B. C. G., the method of the preparation of B. C. G. vaccine, the toxicity, the antigenic properties of the vaccine, the tuberculin preparations of the B. C. G., the histologic picture of the lesions in vaccinated animals, and all the criticisms of the B. C. G. method, are important and interesting topics.

In conclusion, the work of Dr. Calmette as revised and published by his collaborators, A. Boquet and L. Negre, presented in a very well bound volume and profusely illustrated with photographs, the majority of them in natural colors, constitutes a great piece of research that should be appreciated by all biologists, medical men, and veterinarians dedicated to and interested in the important research problems of tuberculosis.—C. M.

The Intimate Side of a Woman's Life. By Leona W. Chalmers. Foreword by Winfield Scott Pugh. Radio City, New York, Pioneer Publications, Inc., c1937. 128 pp., illus. Price, $1.50.

It takes a medical mind and medical experience to see the need for much more wide-spread information on feminine hygiene, and this book will serve that purpose highly. On the other hand, it takes an adequately informed lay woman to write on this subject in a manner easy to follow by the lay reader. Not only gynæcological diseases, but also many psychological and psychoneurotic tendencies, deficient vitality, and even certain internal diseases, are directly or indirectly traceable to improper feminine hygiene.

The contents include general information on the female pelvic organs; a simple physiology together with pathological influences of neighboring organs, and a frank discussion of sex hygiene and of the paramount importance of general body cleanliness and exercise. The text has its weak points, but as a whole it is exceptional in its clarity and frankness.—I. F.

A Note-Book of Tropical Agriculture. Compiled by R. Cecil Wood. Trinidad, B. W. I, The Imperial college of Tropical Agriculture, 1937. 147 pp. Price, 5s 3d.

This little book carries facts and figures concerning tropical agriculture. It was first published in 1933 by the Imperial College of Tropical Agriculture, Trinidad, B. W. I. The book under review is the revised edition.

The author, R. Cecil Wood, Professor of Agriculture in the Imperial College of Tropical Agriculture, has compiled the contents of the book from many authentic sources, with the acknowledged assistance of his colleagues on the staff of the Imperial College of Tropical Agriculture.

The book covers a wide range of helpful aids, to wit: Facts and figures concerning weights and measures, mensuration and surveying, buildings and roads, machinery, labor, soils, manures, crops, foods and feeding, live stock, dairying, formulas for insecticides, fungicides, baits, and statistics. Being of a handy size, it can be carried in the pocket for ready reference in the field. For the convenience of users, blank pages for notes are inserted to alternate with the pages of the text. To teachers and students in agriculture, as well as to farm managers, administrators, farmers, and agricultural extension workers, this book is a valuable guide.—P. L. P.

The Objective Rate Plan for Reducing the Price of Residential Electricity. By William F. Kennedy. New York, Columbia University Press, 1937. 83 pp., tables, charts. Price, $1.25.

The experience of the Commonwealth and Southern Corporation, the originator of the objective rate plan, is thoroughly analyzed in this book, including data of 49 other companies that have applied the plan. It describes the history, application, and results of the objective rate plan. This treatise gives very convincing proof of the possibility of rate reduction without the financial hazard of an outright rate reduction, something to be seriously considered by electric-plant operators. From the point of view of consumers, it shows how they can use more electricity and pay comparatively smaller amounts. Electric-plant operators should read this book.—F. D. M.

Out of the Night; a Biologist's View of the Future. By H. J. Muller. New York, The Vanguard Press, 1935. 127 pp. Price, $3.

Here is a book predicting the future of the human race under the management of progressive eugenics. According to the author, the central theme of the book "lies in the attempt to show that for a continuance of material, cultural and biological progress in the human race, a thorough-going economic and social change to a more truly coöperative basis of society, together with the regeneration in human motivation attendant upon this, is a prior necessity." The author has stressed the "possibility of positive biological improvement of mankind, *provided* the social reconstruction occurs first." Muller envisions the final severance of love and reproduction. Marriage would continue, but birth control would be practiced; children would be produced by artificial insemination of women with the seed of the outstanding men that the race produces. The book gives a fascinating view of biology by a geneticist who is convinced that economic, social, and intellectual changes resulting from scientific progress will effect a real biological up-building of humanity. The book is without an index.—P. S. S.

The Science of Animal Life. By Arthur Ward Lindsey. New York, Harcourt, Brace and Company, 1937. 656 pp., illus., glossary, bibliography, and index. Price, $3.75.

This book is divided into six parts. Part I deals with the "Foundations of Life," discussing biology or the science of life; living matter; metabolism; and the cell or the unit structure of living matter. Part II, "Organization and classifica-

tion of animals," has such subjects as the classification and organization of animals, Protozoa, the diploblastic phyla, the worms, animals of uncertain relationship, Echinodermata, Mollusca, Arthropoda, and Chordata. Part III, "Maintenance of the individual," is discussed under the following topics: The animals and their physical environments; the interchange of materials or food, oxygen, and wastes; the internal environment; communication and government; growth and repair; and the relations of animals. Part IV, "Maintenance of the species" is concerned with reproduction, development of the individual, and heredity. Part V, "Problems of origin," is confined to the discussion of the origin of living things and the process of evolution. Part VI deals with very interesting dissertations on Man and his origin, man's environment, biological problems of society, and the future. The book ends with the very valuable working glossary, bibliography, and index.

The book is unique among the various existing text books on biology in that "it leans more toward principles than toward forms, yet it undertakes the illustration of all points with abundant facts from the animal kingdom." In this way the text leads the student to a broader point of view, hence the fundamentals he learns are more readily applicable to various examples of the animal kingdom. Thus the book becomes more interesting from chapter to chapter, with the result that the students develop fondness for the book as they use it from day to day.

The book under review should, therefore, receive acceptance among our colleges and universities giving courses in animal biology.—D. V. V.

Snakes and their Ways. By C. H. Curran and Carl Kauffeld. New York, Harper & Brothers, Publishers, 1937. 285 pp., illus. Price, $3.50.

This book certainly gives its readers a better understanding of the snakes, a group of animals long regarded as evil creatures to be feared. The snakes have a definite place in the world, as they play an important rôle in maintaining the "balance of Nature." There are snakes that eat other snakes; snakes that prey upon destructive rodents; snakes that feed upon useful animals such as worms, frogs, and birds; snakes that constrict and devour large animals, such as hogs, deer, and even man; and still there are snakes that feed upon harmful and useful insects.

This book has also shown the need for widespread knowledge of the habits and natural history of the snakes. Familiarity with the poisonous and the nonpoisonous snakes should result in the reduction of the incidence of death from snake bites to the minimum. It has been definitely known that in the Philippines cases of death due to snake bites are to a certain extent caused by fear rather than by the poison itself. As a matter of fact poisonous snakes are relatively rare as compared with the nonpoisonous.

This book present a very comprehensive treatise on the natural history as well as on the mythological and religious aspects of the history of the snakes. Moreover, it is easy and interesting to read, because of its excellent literary and historical account of the animals in question. In this book, therefore, are combined the scientific and general accounts of the snakes, making it easily understood and appreciated by both the technical man and the layman.

Chapter II of this book, which deals with snake poisons and the treatment of snake bite, should prove of interest to physicians, herpetologists, and the general public.—D. V. V.

A Textbook of Bacteriology and Its Applications. By Curtis M. Hilliard. Revised edition. New York, Ginn and Company, c1936. 339 pp., illus. Price, $3.50.

This book presents a general knowledge of some of the fundamental concepts of bacteriology in relation to the daily life of men. Together with its scientific aspects, it offers the reader a review of the history and evaluation of this important branch of science. It interestingly discusses the life and scientific activities of such great men of science as Edward Jenner, Louis Pasteur, Joseph Lister, and Robert Koch, whose investigations are of immense value to students and research workers in the search for a better understanding of bacteriology.

Unlike other textbooks on bacteriology, which cover only the medical aspect of the science, this book includes a treatise on economic biology that is of great significance to industry. The author gives a brief description of various molds, yeasts, and bacteria concerned chiefly in industrial fermentation. The biological activities of these may draw the basis of more advanced work by research workers in various industrial fields. It also includes a study on soil bacteriology and the rôle played by microörganisms in scientific agriculture. Also of great importance, especially to students of home economics, is the prac-

tical treatise on the scientific methods of food preservation, a process involving the general principles of antisepsis and disinfection.

To the students of bacteriology this book will serve as a guide in the study of the cultural characteristics of bacteria. In detailed outline form, which is clear and easy to understand, the author presents the general laboratory methods of identifying them. We are also informed of the various factors which influence the existence of bacteria in nature; such as their nutrition and environment. On the basis of the factors favorable to their growth, appropriate methods of suppressing them can be devised, and consequently, the diseases they produce can be controlled.

Through this book the readers can obtain comprehensive knowledge of the proper procedure for conducting biological investigations of the common food materials in relation to the health of men, such as water, and milk and dairy products. This study deals thoroughly with the bacteriological as well as the epidemiological aspect of the problem. Various infectious diseases frequently encountered in everyday life are widely discussed.

The last chapter of this book shows the composition and activities of a well-organized public health laboratory. An institution of this nature is an indispensable factor in the protection of the health and welfare of the people.—P. J. A.

The World and Man as Science Sees Them. Edited by Forest Ray Moulton. Chicago, University of Chicago Press, 1937. 533 pp. Illustrated with many linecut and halftone illustrations. Price, $3.

This is a symposium on the present progress of the physiological and biological sciences. The authors of the various chapters are professors at the University of Chicago. The editor, who is a noted astronomer, opens the book with the chapter on astronomy. The other subjects treated are: Origin and history of the earth, particles and waves, chemical processes, the nature and origin of life, the problems of life and reproduction in the plant kingdom, evolution and behavior of the invertebrates and the vertebrates, physiological processes, microörganisms and their roles in nature, and man. Each chapter surveys the subject in its broad field, giving fundamental knowledge on the science of life and matter. Students of the sciences in colleges and universities, who should have fundamental knowledge of the physical and biological sciences, as well as

others who want to have current information on the subjects treated, will profit much by reading this book. This work is especially useful to teachers of general science in high schools.
—P. S. S.

Your Stammer and How to Correct It. By H. St. John Rumsey. With a foreword by W. W. Mollison. London, Frederick Muller Ltd., 1937. 88 pp. Price, 3s 6d.

This book is an authoritative discussion of the nature, cause, and methods of correcting stammering. The author is an authority on the subject, having been head of the speech clinic at Guy's Hospital for fifteen years, where thousands of men and women suffering from speech defects have come to his attention. As stated in the preface, the author's aim in writing this book is "to clear the atmosphere by explaining to my readers how respiration, the vocal tone produced in the larynx and the articulatory movements of the tongue, lips and jaws are coördinated into speech in the normal speaker, and how, and why, in the case of the stammerer this co-ordination breaks down." The author has pointed out that the cure of stammering may be accomplished through well-directed instructions and the will of the patient to correct himself. While the reading of this book will be highly profitable to stammerers, it will not do away with the need of a speech therapist to effectively correct their speech defects.—P. S. S.

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[New names and new combinations are printed in **boldface.**]

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